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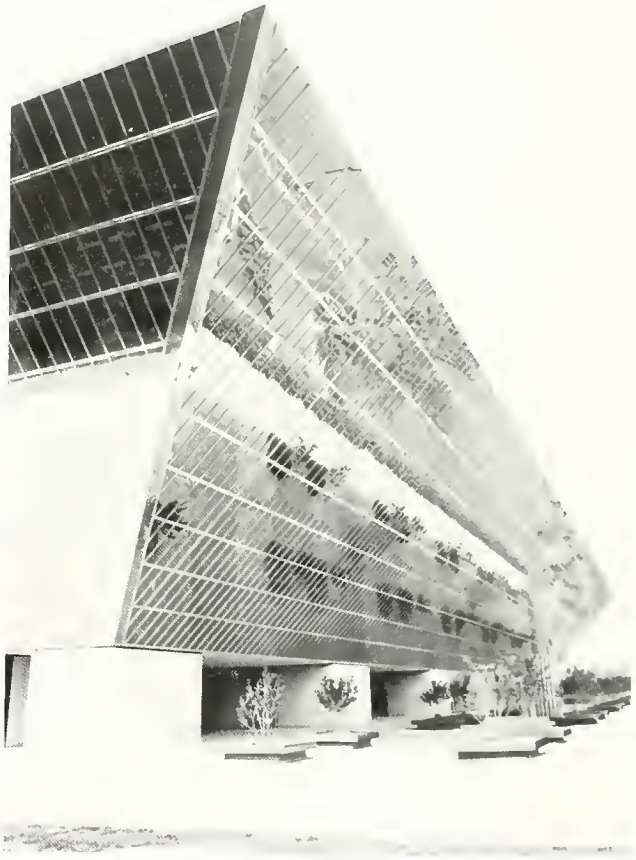

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- a policy-oriented magazine focusing on planning problems and issues as they relate to North Carolina
- of nationwide importance as the issues discussed are often those confronting states and localities throughout the country
- published semi-annually by the Department of City and Regional Planning, University of North Carolina, Chapel Hill.

Previous Publications

Grants used for the initial publications of *Carolina Planning* were designed to help the magazine become self-sufficient. In order to achieve this goal, we are depending upon reader subscriptions to finance continued publication.

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Cover photos by John Manuel depict the changing scene of Chapel Hill and environs.

introduction

In the State of North Carolina and in the nation as a whole, the legitimacy and desireability of city and regional planning has yet to be fully established. Fortunately, there is a growing recognition in many circles that planning is a necessary element of all our attempts to maintain and enhance the quality of life. Yet there are many who still oppose the idea of planning, who cannot accept or do not understand that "planning" implies no more than deciding what we as a community, state, or nation want out of life and working toward those goals in a conscientious manner. Through the publication of *Carolina Planning,* we hope to present North Carolinians with an in-depth look at some of the many areas where planning is or should be involved. These are not limited, as many think, to the much-advertised problems of our central cities, but include such diverse activities as health care, rural development, natural resource management, airport expansion, and new town location to name several. Few, if any, residents of North Carolina are unaffected by these issues - all of us should be deeply concerned with them. We at *Carolina Planning* hope you will take the time to read these articles and give us your feelings on them, or write to us about other issues that concern you. Any suggestions as to how we might improve our publication would also be welcome.

john manuel,
editor

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merryl edelstein

benefits and drawbacks of the national flood insurance program

As amended by the 1973 Flood Disaster Protection Act, the National Flood Insurance Program (NFIP) offers communities across the country insurance protection against flood damages in return for the institution of land-use controls guiding development away from flood-hazard areas. The bargain seems fair on the surface, and many communities have subsequently enrolled, but growing doubts as to the program's efficiency and equitability now lead many to conclude that enrollment in NFIP is, in many instances, undesireable.

What are the actual consequences for development implied by NFIP? Is the insurance end of the program working at odds with the land-use control aspect? What does the act imply for a town whose business district lies wholly or partially within the 100-year floodplain*? While it is too early to give definite answers to these questions, a careful examination of the flood insurance program points to a number of possible problems.

Preliminary indications are that the insurance aspects of the program may not have the desired effect of bringing flood plain development into conformity with the flood hazard. In fact, when insurance rates are subsidized, the effect may be to stimulate growth in flood hazard areas, since land owners are paying insurance premiums that are less than the likely flood losses in the long run, and at the same time are eliminating the risk of large, unexpected damages by paying a yearly premium. Secondly, the uniform national standard (100 year flood) on which the accompanying land use controls are based may not reflect the desired trade-off between benefits and costs of developing a flood plain in local situations. This article will consider the likely effects of both the insurance and land regulation elements of the NFIP on flood plain land use. It will also look into the difficulties inherent in an act which seeks to combine both insurance and land-use controls into a single program.

*Defined as the area which has a one percent chance of being inundated in any given year.

background

The National Flood Insurance Act[1] was enacted by Congress in 1968. Before this time, insurance had not been a possible adjustment in flood hazard situations. Because of the high risk and size of flood losses, private companies believed the insurance premiums needed to back a venture in areas subject to flooding would be high. If so, few policies could be sold, and risks would not be sufficiently spread to merit investment. An early attempt at government aid was the Federal Flood Insurance Act of 1956,[2] but no workable program was developed and Congress refused to appropriate funds.

Interest in flood and other disaster insurance continued, however, especially after events such as the floods of 1962, the 1964 Alaska earthquake, and Hurricane Betsy in 1965. Following Betsy, the Southeastern Hurricane Disaster Relief Act[3] directed a restudy of financial assistance programs for flood victims. The resulting report concluded that a flood insurance program was feasible, and could serve to discourage "unwise occupance of flood prone areas", as well as help individuals bear the risks of flooding.

It was felt that if insurance premiums made explicit the costs of flood plain occupance, it might discourage development that would be uneconomic in the long run. The advantages of flood plain sites (such as level topography, scenic resources, etc.) were acknowledged. But research had also shown that individuals often misperceive the flood hazard.[4] The report proposed that "Flood insurance would be particularly valuable to those prospective occupants of flood hazard areas who make rational choices based upon weighing advantages and costs."[5] *Actuarial* insurance rates, proportional to expected flood risks, would be developed based on average annual damage rates. (These are calculated from the relationships between frequency of flooding, depth, and damages.) Ideally, this type of insurance premium would be a means of informing prospective occupants about the costs of flooding, as well as ensuring that they bear them.

Congress recognized that intensified use of flood-prone areas led to increasing damage potential. Therefore, as a precondition to acceptance into the program and the sale of insurance, the 1968 Act required a community to "have adopted adequate land use control measures (with effective enforcement provisions)" consistent with Federal criteria. The aim was to guide development away from

Merryl Edelstein graduated from the Department of City and Regional Planning at the University of North Carolina, Chapel Hill, in 1976. She has written several environmental impact reports, including one for stream channelization.

hazardous areas in order to reduce future flood damages.

The 1968 Act established a voluntary program administered by the Federal Insurance Administration (FIA) in the Department of Housing and Urban Development (HUD) with policies sold by private companies. Insurance was made available only in communities accepted into the program. However, its voluntary nature encouraged only a low rate of participation. In 1972, only 2% of the $3.2 billion in damages caused by Tropical Storm Agnes was covered. A Government Accounting Office (GAO) report estimated that while a third of identified communities had joined, another 20% claimed they were unaware of the program's existence.[6]

"Ironically, a community which neither expects nor desires future development of its flood hazard areas might better control development there by abstaining from the program"

Subsequently, the Flood Disaster Protection Act of 1973 was passed, amending the 1968 Act. It made participation, and therefore enactment of minimum land use control measures virtually mandatory for most communities by providing that no agency approve Federal financial assistance for construction or acquisition purposes (in designated flood hazard areas) unless the community is participating in the NFIP. These rules went into effect July 1, 1975, except for commercial loans on existing property, which must comply by January 1, 1976.[7]

Just under 2,000 communities were listed in the November, 1975 Federal Register as not participating in the National Flood Insurance Program. Ironically, a community which neither expects nor desires future development of its designated flood hazard areas might better control development there by abstaining from the program, since failure to enroll precludes federally-approved financing in the flood hazard areas.

However, because the expanded program is still fairly new, there is still little empirical information on the actual effect the present policy is having on flood plain development. FIA has been concentrating on identifying and enrolling communities in the program, and has been fairly successful, but monitoring has been neglected, thus, information on enforcement of adopted land use regulations and its impact is limited.

overview of nfip

There are two phases embodied in the National Flood Insurance Act, the "emergency" phase and the "regular" phase. Communities enter under the emergency phase, where subsidized insurance is available for all buildings in flood-prone areas.

Development in flood plains acts as a deterrent to commerce in many instances

Courtesy of Department of Natural and Economic Resources

Flood-prone areas are located with a Flood Hazard Boundary Map (FHBM), which indicates the approximate extent of the 100-year flood plain as perceived by a Washington-based hydrologist (using U.S.G.S. topographical maps).

After the community enters the program, FIA contracts with other agencies, such as the Army Corps of Engineers, to prepare more detailed, accurate flood hazard studies. These establish the elevation of the 100-year flood, and more importantly, the 100-year flood plain. At this point, three things happen. Communities have 6 months to enact additional land use control measures, which require elevation or floodproofing of structures in the hazard area to the level of the 100-year flood. Second, information is provided to establish a floodway, where development which increases flood levels is to be prohibited. Finally, the FIA establishes actuarial insurance premiums through publication of the Flood Insurance Rate Map (FIRM). From this point, new construction can no longer pay the subsidized rate.

flood insurance under the emergency program

In the emergency phase, only half of the program's total coverage limit is available (the first "layer") and rates are highly subsidized to encourage participation. Limits and rates per $100 are:[8]

Use	Total Coverage	Subsidized Rates (for half of total coverage)
Single family residential	$ 70,000	.25
Other residential	200,000	.25
Nonresidential	200,000	.40
Contents, residential	20,000	.35
Contents, nonresidential	200,000	.75

Under the 1968 Act, no insurance was available for new construction undertaken during the emergency phase and actuarial rates went into effect as soon as an area was identified by FIA as having special flood hazards. If the structure was later sold, insurance, if available , would have to be purchased at the actuarial rates. The 1973 Act changed this original policy so that actuarial rates apply only to structures built after publication of the FIRM.[9] Until then, new construction is treated no differently from pre-existing structures, which means that insurance rates are subsidized.

flood insurance under the regular program

When the regular phase begins, the total limits of coverage (the first and second "layers") become available. For buildings beginning construction before the effective date of the FIRM, the first layer of coverage is available at the lower of the subsidized or actuarial rates. Actuarial rates only apply to the second layer of coverage, with a maximum rate of .50 per 100 for one-to-four unit residences. For new structures, actuarial premiums apply for all insurance coverage.

effect of insurance on land development

The amount of subsidy for any unit depends, of course, on what the true actuarial rates would be. For low hazard areas, the actuarial rates are less than the high hazard areas. Average annual damage figures suggest that most occupants of the 100-year flood plain will find it to their advantage to purchase subsidized insurance, and most of those outside the area will not. However, a sample of 48 cities noted that the average annual damages for zones of equal risk varied widely.

Because subsidized rates are not proportional to actual risk, however, they do not act as a refined mechanism for bringing development into patterns consistent with the flood hazard (as actuarial rates are supposed to do). Furthermore, individual responses will depend on personality, as well as the perceived costs of flooding. For example, if individuals wish to avoid floods entirely, the designation of flood hazard areas alone should be enough to discourage use of flood plain sites since locating outside the floodplain is the surest way to avoid flood damages and risks. On the other hand, existing Federal policies with respect to income tax and disaster relief are such that any mandatory insurance premiums, subsidized or not, may represent an increase in the cost perceived by individuals. As such, subsidized premiums, even in high risk areas, may discourage some development of flood plain sites.

This is not to say that subsidized insurance will lead to optimal or even desirable floodplain use. For some people, it is likely that subsidized insurance will reduce the risks and costs of flood plain occupance when flood insurance is purchased. Risks, defined as the variability of year to year losses, are virtually eliminated up to the limits of coverage for the site occupant and shifted, instead, to the underwriter of the policy. Actual damages (*costs*) of flooding are not reduced by insurance. But the individual reduces his own costs if the premiums he pays add up to less than the expected flood damages—an occurrence that is especially likely with subsidized premiums. Therefore, in some instances the availability of flood insurance (particularly subsidized insurance) *increases* the desirability of flood-prone land, by negating the risks. This could lead to increased damage potential.

Some might argue this increase in damage potential may be justified by the advantages of flood plain sites—(low land costs, scenic and recreational amenities, or proximity to services and other complementary land uses). But since subsidized premiums are entirely independent of the actual expected flood damages at a site, they give individuals no true indication as to the damage potential (cost) which should be weighed against such advantages.

Much commercial development has already occurred in flood prone areas

Courtesy of Department of Natural and Economic Resources

Flooding along Crabtree Creek in Raleigh, North Carolina

Courtesy of Department of Natural and Economic Resources

flood plain management regulations

Land use control measures (or "flood plain management regulations") are required as soon as a community is accepted into the National Flood Insurance Program and are strengthened as more detailed flood hazard information is provided by the FIA. The Federal legislation requires minimum standards, but local governments may adopt more restrictive regulations.

Specific land use criteria are promulgated by FIA as four partially overlapping sets of criteria for riverine flood hazards areas (there are additional criteria for coastal hazard areas). The first two measures, which must be enacted before a community is accepted into the emergency program, require a building permit program and an indication that flood hazards will be considered during review of development proposals. (Design and construction requirements include anchoring and other actions to "protect", "minimize", "reduce exposure", etc.)

Given such general terms and the limited hazard information available in the emergency phase, it is doubtful that unwilling communities will impose extremely restrictive standards. To do so could result in legal challenges on the grounds of denial of due process—that is, a lack of reasonable and substantial connection between the restrictions and promotion of public health, safety, and welfare. The U.S. Water Resources Council found that "no court has suggested the detail or accuracy of flood data needed for sound regulation to meet due process and equal protection requirements."[10] The possibility that strict regulatory measures will be adopted by communities, but not enforced, is made more likely by the admitted lack of enforcement supervision on the part of FIA. At this point, the only systematic follow up to the establishment of flood plain regulations is a required annual report to FIA.

The third set of criteria is to be enacted within six months of the date of FIA's final determination of flood elevations. At this point, data has been compiled on which to base specific elevation and floodproofing requirements. Residential structures are required to elevate the lowest floor above the level of the 100-year flood. Nonresidential structures, likewise, must be elevated or floodproofed to the level of the 100-year flood. Information on elevations and floodproofing certificates must be kept on file so actuarial premiums can be determined. Also, for any use it must be shown that the cumulative effect of the proposed use, when combined with all other existing and reasonably anticipated uses of a similar nature, will not increase the water surface elevation of the 100-year flood more than 1-foot at any point within the community.

> "Land use control measures are required as soon as a community is accepted into the program, and are strengthened as more detailed flood hazard information is supplied by the FIA"

These provisions, while increasing the cost of flood plain development, do not necessarily preclude it. The burden of showing less than a 1-foot increase in flood elevations may be an incentive to locate elsewhere. However, if the advantages of a flood plain location are great enough, both the costs of required measures, and of providing information regarding impact of flood heights (and possibly of building offsetting drainage or channel improvement works), may be outweighed. The required land use measures, in a sense, are analogous to actuarial insurance premiums in that they represent costs which must be borne by those who wish to occupy the flood plain.

The fourth set of criteria apply when information sufficient to designate the 100-year floodway is provided. A floodway is defined in terms of the area needed to convey the waters of a flood of a given magnitude (e.g. the 100-year flood) without raising water surface elevations more than a certain amount. FIA criterion list one-foot as the maximum allowable increase. Other jurisdictions have been more restrictive—Illinois, for example, has adopted a 0.1 foot standard. In order to designate a floodway,

information on floodplain and channel cross-sections, as well as flood elevations, is needed. It is generally assumed that areas outside the floodway will not convey flood waters and will thus be safe for development.

Once a floodway has been designated, no fill or encroachments are allowed within its boundaries which might impair the passage of the waters of a 100-year flood. An exception is made where the effect on flood waters is fully offset by stream improvements. Elevation and floodproofing requirements in the third set of criteria still apply to the remainder of the 100-year flood plain. Again, insurance premiums will not be the major costs to developers, since structures will have to be built to survive the 100-year flood with minimal damage. Rather, the major costs which must be weighed against benefits are those of reducing susceptibility to damage from floods up to the 100-year level. These costs are not indicators of the expected flood damages at a site, as would be actuarial insurance premiums based on frequency-damage relationships. The only properties which would be subject to high actuarial premiums are unprotected structures (those built before establishment of the 100-year flood elevation), for the second layer of coverage.

summary

Basically, then, NFIP is a single-purpose program aimed only at damage reduction. However, floodplains are often the site of natural resource values which are not recognized by the program's land use requirements. Fill and construction, for example, are allowed in the floodplain. Such activity may limit flood storage capacity, destroy natural and scenic resource values, lead to increased depths and velocities which result in erosion and channel scour, as well as create a potential for catastrophic loss of life and property from floods larger than the 100-year standard. Technically, a community is free to enact more restrictive land development controls which might avoid some of these costs of flood plain development. Politically, however, the effect of minimum Federal standards may lead to an "If it's good enough for the Feds, it's good enough for us" attitude.

On the other hand, a community might wish to enact less restrictive controls, if the benefits of flood plain development outweigh the costs. All of the data and criteria provided by FIA are based on the flood with a one percent of occuring in any year (the 100-year flood). The Senate Committee Report accompanying the 1973 Act stated that "the standard is established in terms of probability in order to achieve uniformity throughout the country as an estimate of degree of risk, without regional discrimination.[11]" This is for purposes of the insurance part of the program. However, both the locational advantages and the severity of flooding associated with each community's 100-year flood plain and elevation will differ. Thus, there is no guarantee this standard will result in an equitable burden among regions in terms of the foregone positive net benefits from socially-desirable flood plain uses which are not allowed.

Courtesy of Department of Natural and Economic Resources

"Even with the emphasis on land-use controls, no mandatory land-use planning requirements exist in NFIP"

In these instance, there are exception procedures in which "the Administrator recognizes that exceptional local conditions may render the adoption of a 100-year flood standard or other standards contained in this subpart premature or uneconomic for a particular community." When such an incident arises, a community may adopt ordinances less stringent than the minimum federal standards, which the Administrator accepts with only cusory review. Federal regulations concerning this kind of special land use control are undergoing revision, however, and the proposed regulations are more strict.

Even with the emphasis on land use controls, no mandatory land use *planning* requirements exist in NFIP. The regulations which contain the land use criteria (control measures or regulations) only contain "planning considerations" for flood-prone areas. Such considerations include the goals of flood plain management and factors which should be taken into account in formulating goals and regulations. Thus, the program emphasis is toward action in pursuit of damage reduction, rather than planning in pursuit of multiple goals.

In summary, the insurance aspects of the NFIP do not lead to "rational" development as foreseen in the 1966 report by HUD. Except for a short transition period between the emergency and regular phases, when actuarial rates apply but stringent land use measures are not yet enacted, insurance rates will not indicate the long-run economic costs of flood plain occupance. The role of actuarial premiums will be to stimulate adjustments such as stream control or floodproofing which reduce damage to existing development, rather than to influence the location of new development. Most probably, the elevation and floodproofing measures (and their costs) and the limitations posed by floodway criteria will be the major development guidance aspects of the Program. It is entirely another question as to whether the land use control measures contained in this single-purpose program, and geared to a uniform (100-year) flood, are a rational basis for decisions regarding the use of flood-prone lands.

Footnotes

[1]P.L. 90-448, Aug. 1, 1968, 82 Stat. 572

[2]P.L. 1016, 84th Congress, 70 Stat. 1078

[3]P.L. 89-339, Nov. 8, 1965,

[4]Kates, Robert W., *Hazard and Choice Perception in Flood Plain Management*. Dept. of Geography Research Paper #78 U. of Chicago Press, 1962. See also,
Slovic, Paul et al., "Decision Processes, Rationality and Adjustments to Natural Hazards" in *Natural Hazards: Local, National and Global* ed. Gilbert F. White. N.Y.: Oxford Univ. Press, 1974. pp. 187-205.

[5]U.S. Senate, Committee on Banking and Currency, *Insurance and Other Programs for Financial Assistance to Flood Victims*. Committee Print, 89th Congress, 2d. August 1966. U.S.G.P.O., p. 48.

[6]U.S. General Accounting Office, *Actions Needed to Provide Greater Insurance Protection to Flood Prone Communities*, Report B-178737, July 19, 1973. U.S.G.P.O.

[7]P.O. 93-234, Dec. 31, 1973, 87 Stat. 975 s. 202

[8]P.L. 93-234, s101

[9]*Ibid.*, s 103

[10]U.S. Water Resources Council, *Regulation of Flood Hazard Areas to Reduce Flood Losses*, U.S.G.P.O., 1971. p. 30

[11]U.S. Senate, Report 93-583, *op. cit.*, p. 5.

craig richardson

a new hurricane protection plan for north carolina's barrier islands

Scenario

Scene: Palm Isle Beach, North Carolina
Date: August 15, 1976
Time: 6:00 a.m.

Only 8 hours earlier, the numerous vacationers visiting Palm Isle Beach had breathed a casual sigh of relief. The hurricane advancing up the eastern seaboard had seemed to be sliding out to sea toward the northeast. The hurricane warning which had been in effect earlier in the day was lifted. The visitors settled down for a peaceful night of rest.

The weekend had proven bad enough for the crowd of vacationers enjoying their last opportunity of the year to bask in the Carolina ocean sun. Rains and high seas had begun Thursday night with the threat of a hurricane and continued through Saturday. But with the storm's movement out to sea, the possibilities for a subsequent week of sun, fishing, and surf seemed good.

But events changed dramatically. About 11:30 p.m., August 14, the storm took an abrupt move westward, heading for the southeastern North Carolina coast. Within the hour, weather service offices at Wilmington and Cape Hatteras re-issued a hurricane warning for Myrtle Beach north to Cape Hatteras, stating there was a high probability the hurricane would not move as far to the northeast as predicted, and coastal residents should be prepared to experience hurricane conditions within 9 to 10 hours.

The Office of Civil Preparedness went into action, warning beach residents and vacationers. The hurricane bulletin issued at 3:30 a.m. forecast a storm-surge of 5-7 feet from the North Carolina line north to the Cape Fear River. It recommended that all persons located on the barrier islands be evacuated since the entire area was to be subject to flooding and storm surge. By 5:30 a.m., only one-quarter of the people had been evacuated over the island's single bridge. Heavy winds and rain cut traffic to a crawl. Automobiles began to bottleneck and back onto the island. Several small accidents along the highway accentuated the problem and added to the confusion.

Winds picked up to a steady 40 miles per hour with gusts as high as 60 m.p.h. The Weather Bureau reported wind speeds near the eye of the hurricane to be 110 m.p.h. By 7:30 a.m. the line of cars backed behind the bridge convinced many to try and "wait it out" on the island — and by 8:00 a.m. the emergency patrol was turning people away from the evacuation route as the flood waters began lapping at the bridge's sides. At 8:30 a.m., flood waters reached the top of the bridge and were likewise lashing the shores. At 9:30 a.m., with only half of the population evacuated, the remaining Palm Isle community braced themselves for the brunt of the storm's attack.

introduction

The scenario just outlined is ficticious - in fact no storm of hurricane intensity has affected the North Carolina coast since 1971. But the potential of a similar event occurring at any of the beach communities on North Carolina's barrier islands, and the possibility of such an event inflicting unnecessary loss of life and property damages to beach residents, tourists, and the coastal environment itself, is probable as long as existing hurricane protection measures are continued. What are the chances coastal North Carolina will suffer a hurricane attack? What damages occur when this most dreaded of natural storms strikes? What existing actions are being used to address the hurricane problem? Is the program adequate? If not, what actions need to be included to insure protection of life, property, and the amenities so unique to the coastal environment?

This study attempts to answer these questions for the beach communities located on the string of barrier islands stretching the distance of the North Carolina coast. First, an examination of hurricane occurrences is made to determine the probability of

Craig Richardson is a second year student concentrating in regional land policy and environmental planning at the Department of City and Regional Planning, University of North Carolina, Chapel Hill. Before entering UNC he worked with the Department of Housing and Urban Development's Experimental Housing Allowance Program in Jacksonville, Florida.

hurricane landfall; that analysis is followed by an assessment of damages to life and property by such events. Next, attention is focused on actions used to protect the barrier islands from hurricane attack. The report concludes with an analysis of the existing program and sets forth recommendations for a new hurricane policy and action plan for the local barrier island communities.

is the threat real?

Records of hurricanes along the North Carolina coast prior to establishment of the Weather Bureau in 1879 have proven, at best, sketchy, making classification of these early storms from historical sources a matter of conjecture. For this reason, a record of major North Carolina hurricanes was tabulated since 1896 (see Table 1).

Before proceeding with the analysis, however, it should be recognized that although the assignment of probabilities to hurricane attacks based on historical records is plausible, the prediction of future storms, even in a probabilistic sense, is uncertain. Furthermore, average hurricane return intervals are just that, average return intervals. A recurrence interval of 20 years implies a storm of specified intensity will attack on the average of once in 20 years. The probability of similar storms striking in successive years may be small, but it is not impossible. Frequency of hurricane attack can be misleading to the degree that low percentages underplay the vulnerability of an area to hurricane attack. For instance, a beach community may not have been affected by a major storm in 20 years. However, the community could still be subjected to severe hurricane attack for four or five consecutive years.

"Historical records indicate 33 major hurricanes have affected the North Carolina coast since 1933."

In his *Assessment of Research in Natural Hazards*, Gilbert White indicates the probability of a tropical storm of hurricane proportions hitting the North Carolina coast to be from 5-11 percent in a given year, depending on the location.[1] Historical records indicate 33 major hurricanes have affected the North Carolina coast since 1896.

Table 1**

Major North Carolina Hurricanes (1896-1976)

(1) August 17, 1899
(2) October 30, 1899
(3) July 11, 1901*
(4) September 15, 1903
(5) September 14, 1904
(6) November 13, 1904
(7) September 17, 1906*
(8) July 30, 1908*
(9) August 31-September 1, 1908
(10) September 2, 1913*
(11) July 19, 1916
(12) August 24, 1918
(13) September 22, 1920*
(14) August 25, 1924
(15) December 2, 1925
(16) September 12, 1930
(17) August 22-23, 1933*
(18) September 16, 1933*
(19) July 21-25, 1934*
(20) September 18, 1936
(21) September 21, 1938
(22) August 1, 1944*
(23) September 14, 1944*
(24) August 24, 1949*
(25) August 13, 1953*
(26) August 30, 1954*
(27) October 15, 1954*
(28) August 12, 1955*
(29) August 17, 1955*
(30) September 19, 1955
(31) September 27, 1958
(32) September 11, 1960*
(33) September, 1971*

**Those storms recorded by Paul J. Herbert and Glenn Taylor, "Hurricane Experience Levels of Coastal Populations - Maine to Texas" as affecting the North Carolina coast.*

***It must be noted that in examining the literature of past hurricane occurrences, some degree of incongruity was discovered. Taylor and Herbert in "Hurricane Experience Levels of Coastal Populations - Maine to Texas," sited 19 North Carolina hurricanes since 1900. Carney and Hardy in "North Carolina Hurricanes: A Listing and Description of Tropical Hurricanes Which have Affected the State," list 57 tropical storms in the twentieth century (including the 2 major hurricanes of the 1970's not listed in their 1967 publication). The discrepancy can be explained as a matter of definition. The Herbert-Taylor report used the Saffir/Sim Hurricane Disaster Potential Scale which considers direction, wind speed, cential pressure and other variables affecting the intensity and destructive capacity of the storm. The Carney-Hardy study listed "all tropical storms (on which any record could be found by the authors) which have struck North Carolina, had any appreciable effect on the state, or passed close enough offshore to have been a serious threat to the coastal area."[2] For the purposes of this study, a record of hurricane occurrences since 1896 has been compiled using these two sources, while trying to disclude those storms where little damage was recorded. A hurricane was defined as a storm in which maximum velocity (average wind speed over a 5 minute interval) wind speeds exceeded 50 miles per hour.*

Further analysis of the data (Table 2), through tabulation of hurricane incidents over a ten year period, reveals a relatively stable level of hurricane occurrence over the 8 time periods (between 2-7 occurrences per decade) — indicating that the potential for hurricane attack on the North Carolina coast is relatively consistent.

"A closer analysis reveals the same amount (of hurricanes), 73 percent, have occurred between July 19 - September 19, the last two months of the beach season, when population on the barrier islands is at its highest levels"

time of hurricane occurrence

Another variable meriting consideration in an analysis of hurricane impact is the time of year hurricanes are most likely to occur. In charting the 33 storms affecting the North Carolina coast by month of occurrence (see Table 3), the statistics show approximately 73 percent of past hurricanes struck in August and September (24 of the 33). A closer analysis reveals the same amount, 73 percent, has occurred between July 19-September 19, the last two months of the beach season, when population on the barrier islands is at its highest levels.

damages

Destruction and damage to the North Carolina coast from hurricanes has been great and is increasing. As the records indicate, however, statistics concerning hurricane damages have been lax, at best. Furthermore, even if substantial information on property damages and other losses was available, it would still remain difficult to assess phenomena such as psychological injury, long term losses to the resort economy, the effects of freshwater floods and shifting sands on oyster beds, weakened utility systems, and lost income due to temporary unemployment.[3]

Information on the losses suffered in North Carolina since 1896 from major hurricanes has been compiled (see Table 4). But much of the early information gathered comes from newspaper accounts (sometimes of single incidents) and Weather Bureau reports. Some of the information gives dollar damage amounts for a specific area. Other accounts reveal figures for the entire state. The only detailed account collected was that used in a report on the four hurricanes of 1954-1955.[4]

Table 2

Major Hurricane Occurrences per Decade in North Carolina (1896-1976)

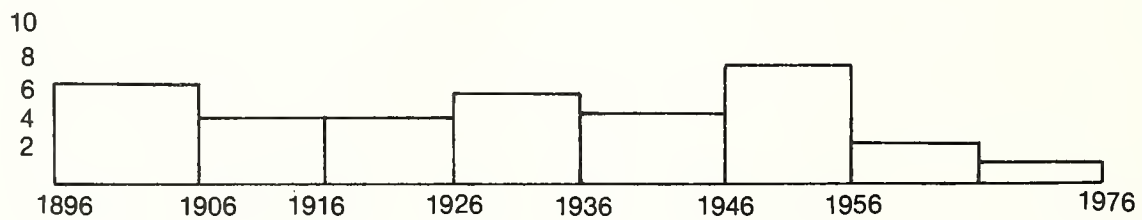


Table 3

Major Hurricane Occurrences by Month in North Carolina (1900-1976)

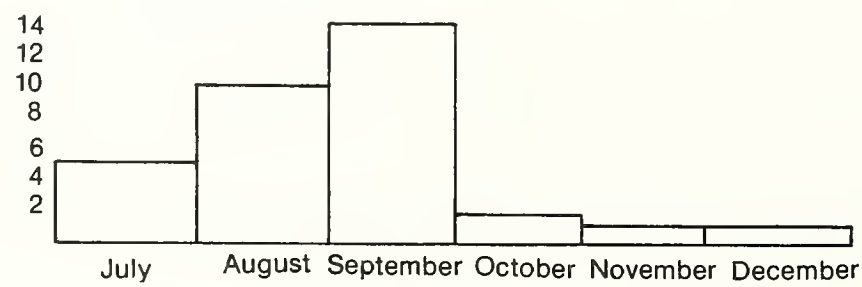


Table 4*

Hurricane	Damages
(1) August 17, 1899	Hatteras Island 4-10 feet under water-all piers and bridges destroyed.
(2) October 30, 1899	Damages around the Wilmington area assessed at $200,000
(3) July 11, 1901	No record of damages
(4) September 15, 1903	No record of damages
(5) September 14, 1904	No record of damages
(6) November 13, 1904	No record of damages
(7) September 17, 1906	Considerable damage to property and shipping
(8) July 30, 1908	Damage recorded as "immense."
(9) August 31-September 1, 1908	Heavy flooding
(10) September 2, 1913	Property damage in North Carolina assessed at $4,000,000-$5,000,000
(11) July 19, 1916	Light damage
(12) August 24, 1918	Light damage
(13) September 22, 1920	Little record of damages
(14) August 25, 1924	Light damage
(15) December 2, 1925	Little record of damages
(16) September 12, 1930	Little record of damages
(17) August 22-23, 1933	Storm damage estimated at $250,000
(18) September 16, 1933	Damage in North Carolina assessed at $3,000,000
(19) July 21-25, 1934	Little record of damages
(20) September 18, 1936	Damage estimated at $55,000 in Hatteras area
(21) September 21, 1938	Light damage
(22) August 1, 1944	Damages in southeast North Carolina estimated at $2,000,000
(23) September 14, 1944	Damage to buildings and crops estimated at $1,450,-000
(24) August 24, 1949	Damages estimated at $50,000
(25) August 13, 1953	Damages to buildings and crops assessed at $1,-000,000.
(26) August 30, 1954	Considerable erosion. Damage to piers, roofs, television antennas estimated at $225,000
(27) October 15, 1954	19 deaths
	Losses to farm buildings 50,500,000
	Minor damage to dwelling units 59,000,000
	Churches and public schools 1,000,000
	Public Utilities 1,800,000
	Municipal and County facilities 8,000,000
	Highways 500,000
	Fishing Industry 1,500,000
	Forests 3,000,000
	Total property damage 125,300,000
(28) August 12, 1955	Agriculture 131,000,000
(29) August 17, 1955	Private Property 49,570,000
(30) September 19, 1955	Public properties and utilities 7,202,000
	Public highways 1,870,000
	Total Property damage 189,642,000
(31) September 27, 1958	Damage at Wrightsville Beach assessed at $221,800
(32) September 12, 1960	Estimates well in the millions of dollars
(33) September, 1971	Light damage

**Damage estimates from the North Carolina hurricanes (1896-1976) were drawn from the North Carolina Council of Civil Defense's* North Carolina Hurricane Project, *and Charles B. Carney and Albert V. Hardy's "North Carolina Hurricanes: A Listing and Description of Tropical Cyclones Which Have Affected the State."*

Courtesy of Department of Natural and Economic Resources

Damage from hurricane storm surge is a threat to the entire North Carolina coast

Even though this information is given on a statewide basis, the majority of damages occurred on the barrier island communities and adjoining farmlands of eastern North Carolina. During these four storms, all the barrier islands were ravaged by storm surge and flooded to varying degrees.[5] Homes were destroyed, businesses flooded, roads ruined, and the area economy overturned for weeks, leaving little doubt about the catastrophic nature of hurricanes. Recognizing the imminent dangers of hurricanes, let us now examine the existing state of the art for hurricane protection along the North Carolina coast.

existing actions

Existing actions used to protect property and life from hurricane attack can be separated into four categories: (1) warning, evacuation, relief, and rehabilitation in the Office of Civil Preparedness, (2) protection through dune stabilization, (3) protection through wind and wave-resistent building design criteria as adopted in the North Carolina State Building Code, and (4) relief and protection through the National Flood Insurance Program.

Until recently, the brunt of this hurricane protection-relief activity has focused upon the first two strategies: the "clear and present danger" measures offered through the Office of Civil Preparedness when hurricane attack is imminent, and the protective dune stabilization program proposed by the Corps of Engineers. The other alternatives, building design criteria and land use controls, have been either neglected (in the case of the North Carolina State Building Code) or just recently implemented (National Flood Insurance Program), and have thus been of little consequence in hurricane protection policies or plans.

warning, evacuation, relief, and rehabilitation

Direct responsibilities for coordination of warning activities, evacuation, relief and rehabilitation during time of hurricane siege rest in the hands of the local Office of Civil Preparedness in each coastal county. These local offices are aided in their planning and preparation by the State Office of Civil Preparedness in Raleigh. The North Carolina program is divided into six geographical regions, each possessing an office coordinator who acts as liaison between the state office and localities. These regional offices advise the local Civil Preparedness Officer, who in turn is responsible for setting up warning systems, evacuation routes, and relief centers for the local areas. The regional offices disseminate materials and information to the county directors with ideas on how to structure a Natural Disaster Preparedness Committee, types of officials to include (i.e., the mayor, the Red Cross, the Police Department, City Engineers, Newspaper Officials, and Television Officials), information on methods for educating the community, aids in planning locations for emergency operating centers, the supplies and other types of equipment needed for the center, and strategy for coordination of community emergency activities with the U.S. Weather Bureau, the North Carolina National Guard, and the State Office of Civil Preparedness.

Presently, all 17 of the coastal counties have a local Civil Preparedness Officer. But, in many cases, the local official is plagued by low public awareness of potential hurricane attack (especially since a

direct hurricane landfall has not occurred since September 12, 1960). Typically, no community action is taken to insure bridge capacities are adequate, and public participation and consciousness of the necessary emergency actions is low. The local Civil Preparedness Officer is forced into a low-key role by the community until a crisis occurs — and then is expected to smoothly direct community-wide evacuation and relief procedures amongst a citizenry unfamiliar with the proper emergency actions.

"... this protection measure (dune stabilization) has proven costly and, in some ways, counter productive as a hurricane policy."

dune stabilization

Dune stabilization, another form of protection, has taken place at various intervals along the state's barrier islands. In its natural condition, the seaward boundary of a barrier island is characterized by a line of shifting sand dunes breached by intermittent overwash fans which provide a natural outlet for exceptionally heavy seas. Dune stabilization involves the strengthening and fortification of sand dunes and the closing of overwash fans, theoretically to prevent a storm surge from flooding the island. However, this protection measure has proven costly and, in some ways, counterproductive as a hurricane protection policy.

The experience at the Cape Hatteras National Seashore and Recreational Area (CHNSRA) dramatically outlines the problems accompanying dune stabilization activities. Shortly after organization of CHNSRA, the National Park Service, in conjunction with the Corps of Engineers, initiated a long-range plan to alleviate the erosion problems generated by the natural processes on the barrier islands. In order to stablize inlets, widen the beaches, ameliorate drainage problems and protect the inhabitants from severe storms, a dune stabilization program was launched.

By the late 1960's the fruits of their labor began to emerge. The steepening of the frontal dunes along the shoreline (the primary form of protection) stepped up the erosion process. The effect of this acceleration can be seen along the Cape Hatteras National Seashore and Recreation Area where the beach berm has been shortened over the past 25 years to 90-150 feet in width (a natural barrier island berm is 400-500 feet).[6] Secondly, with the filling and stabilization of the frontal dune, flood hazard from the sound side has actually increased. On a natural barrier island, a severe flood coming from the sound pushes over the island and is able to dissipate on the ocean side through the overwash fans. However, along CHNSRA where the frontal dunes have been stabilized, the saline water is blocked by the unbroken line of dunes and is forced to remain on the island for days, destroying the vegetation.[7]

In addition to the natural problems created by dune stabilization, there exists a socio-psychological problem which could exacerbate the disruptive character of this kind of hurricane protection strategy in a more developed area. It emerges in the form of a false sense of security which protective dunes encourage. Its shape burgeons with such activities as increased residential and commercial speculation by the developer, second home investment by the homeowner, and the neglect of the other types of protective measures (building design, evacation plans etc.) by the public official — until the record storm occurs, destroying the "stabilized dunes" and all the new development investments behind them.

north carolina state building code

Although neglected by most of the coastal counties and their municipalities, another preventative action designed to protect people and property from hurricanes in coastal North Carolina is embodied in the model North Carolina State Building Code. Due in part to the tremendous damages suffered by the 1954-1955 hurricanes, the General Assembly in 1958 included amendments to the codes for hurricane prone counties to aid in the prevention of building damage from hurricane floods and winds. The requirements are twofold: (1) design, and (2) anchorage requirements to protect buildings from wind and wave action.[8] Requirements for wood and frame buildings included anchorage at roof-to-

Development insensitive to the natural island processes generates unnecessary damages from hurricanes

Courtesy of Department of Natural and Economic Resources

walls, walls-to-floor, floor-to-foundation, and foundation-to-footing joints. Requirements for masonry or brick homes also include that the roof be anchored to the foundation with steel rods.[9]

national flood insurance program

Another program which could prove fruitful in protecting life and property from hurricane attack is the National Flood Insurance Program (NFIP), an effort by the federal government to provide flood insurance to homes and businesses, while discouraging the use of flood prone areas through building and land use restrictions. The program is administered at the federal level through the Department of Housing and Urban Development and in North Carolina through the Department of Natural and Economic Resources, Division of Community Assistance. NFIP is operated as a two phase effort. Phase I, (the emergency phase) is designed to familiarize the counties and municipalities with the program and allow them time to make studies of the flood-prone areas. It requires building permits to be issued for all structures built in the designated flood-prone areas and minimal design considerations be followed when allowing development in flood hazard areas.

Phase II (the regular phase) requirements are more demanding. These include detailed studies of flooding to ascertain specific flood levels, followed by elementary land use controls and building design criteria in the form of flood plain ordinances.

Along the coast, design criteria follow the logic used in riverine systems with the exception of the use of "high velocity" and "non-high velocity" zones. The high velocity zone is that area designated as vulnerable to flooding and wave action during the storm. The non-high velocity zone is the area not plagued by wave action, but still flooded during the storm.

For purposes of flood plain ordinance requirements, the 100-year flood* is used. No discernable difference in terms of design regulations exists between requirements for the "high velocity" and "non-high velocity" zones. Both area ordinances require that the first floor of structures be built at or above the 100-year flood level (in the "high velocity" zone, the building must be above flood waters and wave action) and, constructed on pilings of a break-away nature to allow flood water easy access under the floor.

The effect the NFIP will have in ameliorating hurricane protection, however, is still nebulous. The status of the program along the North Carolina coast varies. Most all communities have entered Phase I (the emergency phase) of the program. But few have been able to complete the studies required to enter Phase II, where some form of land use control and building design criteria are required in the flood hazard areas. Before these more specific requirements have been implemented by the barrier island communities, the efficacy of NFIP in relieving and protecting coastal residents from flood phenomena will remain uncertain.

analysis of existing actions: considering the natural processes

After examining the alternative protective actions against hurricane attack, it becomes evident that one issue vital to a sound hurricane policy is consistently skirted: the effects which human actions (such as building and dune stabilization) have

*The 100-year flood is defined as that flood which has a one percent chance of occurring in any given year.

Roads constructed too near the shoreline tend to disrupt natural barrier island processes

Courtesy of Department of Natural and Economic Resources

on the barrier island's naturally resilient capacities in the face of hurricane siege - and the actions necessary to maintain the natural island equilibrium in order to protect, enhance, and maintain the unique values of the coastal environment. Actually, there would be no natural problems if man did not occupy the barrier islands. By its nature, the barrier island provides a dynamic environment which at first glance appears as nothing more than shifting sands, but actually supports a highly stablized ecosystem.

Tampering with such a sensitive process (many times done when man inhabits the barrier island) creates severe problems. Dune stabilization, plugging the overwash fans, extensive construction in sensitive shoreline areas, or allowing rampant destruction of the maritime forests could throw the island's ecological equilibrium off balance. Proper building design criteria and set-back lines, do not in themselves constitute a comprehensive hurricane policy. Elevated residences could be constructed in overwash fans and be properly set back from the ocean. But obstruction to the island's resilient processes during time of hurricane siege might still occur if homes block the passage of storm surge from the shoreline or floodwaters from the sound side of the island. Only when building design criteria and set-back lines are integrated with sound land use controls will the viability of these resilient processes be maintained.

"Design criteria for buildings should be adopted in the form of (1) standards required by the National Flood Insurance Program (pilings and elevation requirements) and (2) the standards from the North Carolina State Building Code."

A hurricane policy, then, must strike a sensitive balance between protecting property and life and the natural processes which make the coastal environment unique. The one-dimensional emphasis on the tasks of the Office of Civil Preparedness and the detrimental and costly dune stabilization activities must shift to a more comprehensive strategy which places heavier emphasis on land use controls and building design criteria. Instead of ignoring the intensity, location, and quality of development on the barrier islands and concentrating on immediate emergencies when they arise, the new hurricane policy and action plan should address these land-use and design issues in order to prevent severe evacuation problems and damages, and protect the barrier island environment.

The dune stabilization program must end. Overwash fans and the dune system should be protected to insure the viability of the natural processes so important to the island's resiliency during hurricane attack. Building elevations and flood-proofing should be required to protect properties from damages and aid in preservation of the natural island environment. Innovative subdivision regulations should be encouraged which sensibly address the natural problems of the island environment. Evacuation capacities should be considered when compiling holding capacity levels. Finally, the warning, evacuation, relief and rehabilitation efforts of the local Office of Civil Preparedness should be given more recognition in the community as it attempts to work in conjunction with these other efforts. More specific tools for action are outlined below.

the action plan

Warning, evacuation, relief, and rehabilitation during time of hurricane attack should continue to be directed by the local Office of Civil Preparedness. Evacuation plans should be drawn for each jurisdiction. A holding capacity should be calculated from these Civil Preparedness reports by each community, and land use controls implemented which assure that all people on the islands can be safely evacuated in the event of hurricane attack. A stronger effort should be made to heighten public awareness of the Office of Civil Preparedness in the coastal communities. Public participation in preparing for evacuation and other emergency procedures should be encouraged.

Another form of rehabilitation is available from the National Flood Insurance Program.* All municipalities and counties should be encouraged to enroll in Phase II of the program as soon as possible. Such actions will make flood insurance available to all homeowners.

Design criteria for buildings should be adopted in the form of (1) standards required by the National Flood Insurance Program (pilings and elevation requirements) and (2) the standards from the North Carolina State Building Code. These should be synthesized into a simplified county-municipal code in which all requirements (elevation above flooded areas with break-away pilings, anchorage, and tie-down requirements for roofs, walls, etc.) are considered. Specific ordinances for mobile home and buildings should include:**

*Even though the National Flood Insurance Program is included in the hurricane strategy, there exists some doubt as to whether it encourages building in fragile areas by subsidizing (through insurance) the participants. Apparently, a compromise has been struck between the "purists" desire to prohibit any kind of development in these areas and the "developers" who argue against any form of control.

**These ordinances have been modeled after those used in the *Comprehensive Land Use Plan, City of Sanibel, Florida*, by Wallace, McHarg, Roberts and Todd.

For Mobile Homes:

(1) Assurance that all structural components (wall, frame, windows, tie downs, etc) can withstand the impact of a 100-year storm.
(2) Assurance that the electrical and sanitary components installed are fitted so as not to be source of untreated effluent or other damages during the 100-year storm.

For Buildings:

(1) Provisions for elevation of the lowest floor of all new construction or any substantial improvements to existing units be *X* feet above mean sea level (*X* feet in high velocity zones being the level at which the structure would not be effected by wave or wind action from the 100-year storm and, in the non-high velocity zones, where the structure would not be affected by flood waters from the 100-year storm. These levels will depend on a number of variables and should be obtained from the Flood Plain studies by the Corps of Engineers).
(2) Provisions that portions of new construction or any substantially improved building which is below required elevation levels be used only for parking, storage, utility rooms, workshops and other uses normally associated with accessory buildings and be constructed of breakaway materials in order to allow storm driven wind and water to pass through the lower portions of the buildings without threatening the integrity of elevated sections of the building.
(3) Provisions that any sewer, water, electrical or other utility service system installed be flood-proofed to at least *X* feet above mean sea level (X feet being the same height as the lowest floor). The applicant must include certification by a registered professional engineer or architect that flood-proofing methods are adequate to withstand pressures from the 100 year storm.[10]

Subdivision Regulations should be adopted which require consideration of the effects man-made design has on the natural barrier island processes during times of hurricane siege. A Planned Unit Development process, espousing flexible means of achieving harmonic design with the natural island elements and containing specific requirements concerning dune setbacks and building elevation levels (as expressed above), would seem most ideal. Such a process should require a road design eliminating the open channel effect produced by constructing roadways perpendicular to the ocean. Likewise, such a process should encourage innovations such as the staggered lot concept and other new designs which push beach development in more environmentally sensible directions.

Zoning Regulations should be drawn by the county and municipalities in conjunction with Areas of Environmental Concern (AEC) categories of the Coastal Area Management Act (CAMA). Such a measure should allow for preservation of those natural areas on the barrier islands critical to the maintenance of the island's resiliency during time of hurricane siege. It should include protection of the dune system (more than the primary dune) and the overwash fans.

This could be done by the insertion of a conservation zone in the local zoning ordinance which follows the same boundaries as the AEC category (see Figure 1). This general conservation zone should have various subcategories, for example, a Conservation-Residential zone, a Conservation-Commercial zone, etc, to accommodate situations where the AEC (and conservation zone) crosses several different local zones. If the standard zoning process is implemented, the allowable uses for each sub-category (Conservation-Commercial, Conservation-Residential) can be defined in conjunction with the AEC guidelines. If some type of evaluation system with a site-plan approval process is used, specific criteria for development in these areas should be defined. As such, this procedure would establish guidelines for the minor development permit process under CAMA, simplify the state-local problems involved with managing areas of environmental concern, organize the AEC concept at the local level, and provide the Coastal Resources Commission specific information which would aid in their review of major developments in the local AEC category.

"(Zoning regulations) should allow for preservation of those natural areas on the barrier islands critical to the maintenance of the island's resiliency during time of hurricane siege."

Alteration of Areas of Environmental Concern in Coastal Area Management Act is needed. As mentioned above, the local zoning regulations for hurricane protection should be implemented in conjunction with the AEC designations of the Coastal Resources Commission. As such, an extension of the Dunelands (Other Dunes) category (6.1.2) under the Natural Hazards section would need to be made. The description should read:

> Ridges or mounds of loose wind-blown material, usually sand which begins on the landward margin of the frontal dune as a series of sand mounds and trough areas that act in conjunction with the frontal dune to aid in protection and absorption of wave and wind energy. They may be barren, partially or completely vegetated with grasses or woody vegetation.

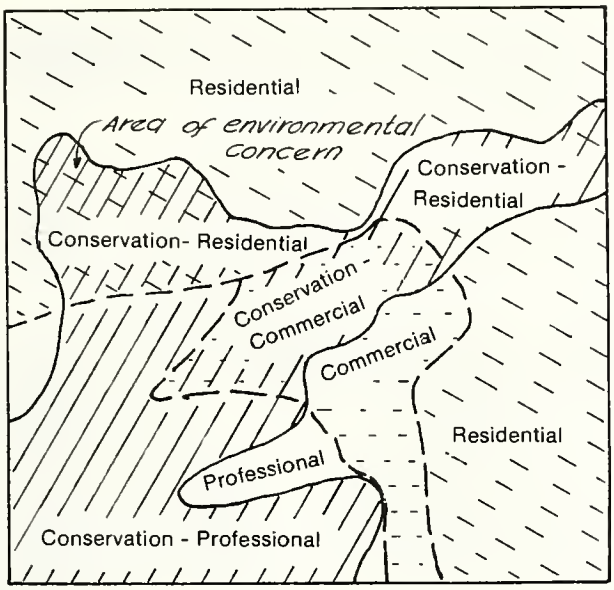


Figure 1

Such a definition allows for consideration of the dune system as a protective barrier against hurricane attack with full knowledge that one day the frontal dune may no longer exist — as a secondary dune takes its place.

Also, an addition to Section 6, Natural Hazard Areas, should be made in the form of a category for Overwash Fans. It should be described as:

> Those tongue-shaped terraces of fans, built by the sand carried from storm overwash. They are found between breaches in the frontal dunes stretching landward. The type and intensity of vegetation depends on the frequency and strength of storm waters which inundate the area.

The overwash fan, along with the dune system, aids in the resiliency and stability of the shoreline during hurricane attack — and by its own composition allows extension of the island's backside, which aids in the maintainance of an ecological equilibrium within the island system.

conclusion

Examination of historical records on hurricane occurrences along North Carolina's string of barrier islands shows the real potential of hurricane attack in this coastal area - an incident which, in all likelihood, would create severe storm surge and untold damages from hurricane flood waters, wave action, and winds. Analysis of alternative action plans for hurricane protection reveals the focus on past programs has fallen short of a truly comprehensive hurricane protection policy on several accounts. First, the focus on past programs has rested solely on the activities of the Office of Civil Preparedness and the impractical protective measures of dune stabilization, while neglecting more preventative actions such as the implementation of building design criteria and land use controls. Secondly, the effects of hurricanes on the critical natural processes working on the barrier islands in relation to human actions (such as dune stabilization and building) and the actions necessary to maintain the natural island equilibrium has not been addressed.

The action plan offered in this study takes consideration of these needed changes by adding more preventative measures in the form of building design criteria and various land use controls. The warning, relief, and rehabilitative activities of the Office of Civil Preparedness are maintained. Dune stabilization activities are ended. New conservation zoning regulations, new subdivision regulations, and building design criteria are added. Finally, a means of coordinating this program with the Coastal Area Management Act is included.

Footnotes

[1]Gilbert F. White, *Assessment of Research in Natural Hazards*, MIT Press, 1975, p. 245.

[2]Charles B. Carney and Albert V. Hardy, "North Carolina Hurricanes: A Listing and Description Which Have Affected the State," revised, 1967, from introduction.

[3]North Carolina Council of Civil Defense, *North Carolina Hurricane Project*, December, 1955, p. 25

[4]*Ibid.*

[5]*Ibid.*, p. 22

[6]Robert Dolan, Paul J. Godfrey, and William E. Odum, "Man's Impact on the Barrier Islands of North Carolina," *American Scientist*, March-April, 1973, p. 159

[7]*Ibid.*, p. 161.

[8]*North Carolina State Building Code*, Volume 1: General Construction, Revised 1967, Section 1205.

[9]*Ibid.*, Section 1408.2.

[10]Wallace, McHarg, Roberts, and Todd, *Comprehensive Land Use Plan City of Sanibel, Florida*, March, 1976, see sections on Mobile Homes and Flood Proofing.

charles pattison

flying into turbulence: the raleigh-durham airport expansion controversy

The Raleigh-Durham Airport Authority (RDUAA) is in the process of expanding its facilities to accommodate current and projected air carrier operations. Five alternative plans have been drawn up by consultants, only one of which is seen as sufficient by the Airport Authority. This alternative, known as Plan B, would send aircraft directly over Umstead Park and a considerable number of homes and businesses. For this reason, Plan B is opposed by many area residents. Strenuous arguments for and against the various alternatives have come from all sides, yet the debate seems bogged down because of a failure to reach a consensus on area needs and desires and a general lack of information on the costs and benefits of the various plans.

Is expansion necessary in the first place or is this merely an attempt on the part of RDUAA to keep pace with competing facilities in Greensboro and Charlotte? Is Plan B clearly superior to the other alternatives? The most significant conclusion is that no one has presented the detailed information necessary to make an intelligent choice between these plans. However, in-depth research suggests that an alternative other than Plan B offers a more modest but totally adequate solution. This article will briefly review the struggle over expansion of Raleigh-Durham Airport and follow with a detailed account of the benefits and drawbacks of each plan as seen by the author.

current history of rdu airport

The Raleigh Durham Airport Authority (RDUAA) originated in 1939 after Durham and Wake Counties together with the cities of Durham and Raleigh successfully petitioned the state legislature to provide enabling legislation for a four-party aviation facility.[1] This legislation allowed each governmental body to be assessed one-fourth of the cost when any bond issues were floated. It also allowed the jurisdiction most directly affected by the airport facility to have a say in its future growth.

By 1968, the RDUAA had documented its need for expansion. The only question was where. Initially, the Airport Authority endorsed a proposal known as Plan A. This scheme called for a new 10,000 foot runway 5000 feet southeast of the existing runway (#5-23) with both runways operating simultaneously. A new terminal would be located between the two runways, and primary access would be from N.C. 54. A controversy ensued, however, when it was learned that the plan would involve an exchange of 350 acres of airport land for 264 acres from Umstead State Park. Local attention focused on this when a newspaper ran a Sunday feature article on a North Carolina State University scientist conducting habitat studies of gray squirrels in that area. The expansion plan would end the research effort when the Park land was traded. The prospect of a land exchange incensed many people, spurring the initiation of a group, Citizens to Save Umstead Park, specifically organized to oppose the Authority's plan. Their claim was that Plan A would require cutting easements on 230 acres of the Park's land with other rights for low level flyovers given on an additional 620 acres.[2] Noise pollution was alleged to affect 1100 of the Park's 5200 acres. The RDUAA justified the plan as its least cost proposal.

The ultimate test for Plan A came in a $20 million bond vote on November 5, 1968. Its failure to pass was attributed to a possible tax increase, the RDUAA/Umstead Park land exchange and a lack of data supporting the Airport's expansion plans.[3]

After modifying Plan A, the RDUAA again tried to arrange a land exchange with Umstead Park in 1970.[4] But the North Carolina State Board of Conservation and Development, along with the National Park Service, refused, [5] forcing the reconsideration of priorities. The RDUAA developed 11 alternate schemes with the aid of a consultant, J. E. Greiner, and the Federal Aviation Administration (FAA). Each of these were discussed by all parties mentioned above. Four were decided to be worthy of

Charles Pattison graduated from the Department of City and Regional Planning at the University of North Carolina, Chapel Hill, in May, 1976. While at the University he majored in transportation planning. He served as an intern with the Guilford County Planning Department in the summer of 1975.

Air traffic controllers monitor flights at Raleigh-Durham Airport
Courtesy of *Raleigh News and Observer.*

more in depth study. They were coined Plan B, Plan C, and Plan C-1. Plan A was retained for comparative purposes only. Plan D, which stretched the existing runway to 10,000 feet was also developed. A subsequent proposal, C-2, has now emerged, and is being endorsed by the airlines through a trade organization, the Air Transport Association of America (ATA).

The Airport Authority has endorsed Plan B and successfully petitioned the Wake County Board of Commissioners to rezone 2000 acres in Wake County in anticipation of the plan's approval.[6] A public hearing scheduled for November, 1973, drew little public response. Shortly thereafter, the FAA offerred tentative approval following further documentation based on the environmental impact assessment due in 1974. These findings were presented with other documents (Physical Development Plan and Financial Report) at a public hearing in December, 1974. A revised impact statement is past due but is still to be released. Although some objections were raised - these will be examined later in detail - the RDUAA felt confident enough to send all the necessary documents on to Washington, urging the FAA's prompt approval of Plan B.

expansion requirements

The Raleigh-Durham Airport is responsible for the aviation needs of the Research Triangle Region, which includes the metropolitan areas of Raleigh, Durham, and Chapel Hill. In the period from 1950-1970, Raleigh's population increased 84% while Durham's grew by 44%.[7] As a regional airport, this facility's expansion is an attempt to keep pace with population growth in order to preserve the economic vitality of the area. The underlying premise here is that added population means increased airport use.

Market studies prepared by two consultants in 1970 and 1972 showed that passenger facilities at RDU were inadequate and that demand for long-haul (1500 miles) non-stop carrier service was increasing.[8] In the period from 1966-1972, enplaned passengers increased by 107% and enplaned cargo tonnage increased by 178%.[9] Enplaned passengers are expected to rise from 712,300 in 1975 to 2,287,-600 by 1995.[10] Total airport operations (landings and takeoffs) will increase from 192,300 in 1975 to 450,000 by 1995.[11] One problem arising from this increase is that the existing terminal cannot accommodate more passengers and existing runways cannot meet the loads presented by heavier aircraft soon to be operating from the airport. In fact, the principal instrument runway will need to be rebuilt in order to handle higher traffic volumes and heavier weight aircraft. Further, increased passenger volumes can only be accommodated through construction of a new terminal. A second problem arises from the fact that the airport has only one fully instrumented runway. Should this runway require major repairs, the entire facility would be shut down. A crash would create the same result. In either case, all passenger traffic would have to be rerouted to Greensboro where passengers would take a bus to Raleigh-Durham. (In each of the alternatives a back-up runway is provided to solve this difficulty.)

"The Airport Authority has only provided a limited amount of data on the alternatives it rejected, whereas complete documentation was offered for the alternatives they selected."

criteria

The criteria adopted as a means of evaluating the alternatives agreed upon by the RDUAA and the FAA are: amount and cost of land to be acquired, operational and safety feasibility of the facilities, development costs, environmental impacts, land use compatibility, and access on and off the airport.[12]

Unfortunately, a proper evaluation of the alternatives has been made difficult due to a lack of information. The Airport Authority has only provided a limited amount of data on the alternatives it rejected, whereas complete documentation was offered for the alternative they selected. Operational and safety feasibility evaluations were done only for one scheme since the others embodied the same

requirements as specified by the FAA. Cost factors considering site preparation, drainage, relocations, and airfield pavements were developed in detailed financial estimates only for the alternatives deemed feasible by the Airport Authority.

Environmental criteria consisted of community noise, air pollution, water pollution (including soil erosion), natural phenomena characteristic of each area, and noise to Umstead Park. Sewage and industrial wastes for all comparisons were found minimal and not considered in detail. Potential land use conflicts were evaluated with respect to impacts on Umstead State Park and the Research Triangle Park. Secondary consideration was given to the number of homes and institutions that might be affected by the expansion.

"The question of reducing general aviation operations out of Raleigh-Durham is important since these flights account for over half of the projected growth through 1995."

Criticisms about the airport's measurement of noise contours and the actual cost savings among the alternatives are being considered in the final draft of the environmental impact statement. Although due in October, 1975, this report was postponed to January, 1976. At this time, the impact statement still has not been released.

alternatives

The consultant preparing the Airport Master Plan developed three alternatives to accommodate the airport's projected expansion. These include (1) the removal of air carrier service from the existing site to an unspecified new location, (2) the removal of some or all of the general aviation operations so no additional runways would be required, and (3) the development of the existing site to its maximum potential by the addition of new runways and other facilities as they are required.[13] A search for new air carrier sites was conducted. However, the nearest suitable location was found to be 40 miles from the present site, outside the jurisdiction of the RDUAA. Subsequent discussions with the FAA about this site concluded that its distance from the present facility would unduly alter the air trade of the area because of its inconvenience, and the investment loss incurred in making such a move would be unacceptable.[14] The removal of general aviation (non-commercial) operations was discussed and found to be possible.

The question of reducing the general aviation operations out of Raleigh-Durham is important since these flights account for over half of the projected growth through 1995 (see the following section, Question 6). However, the consultant felt it was "inappropriate" to make any proposals with regard to this as North Carolina is presently working on recommendations for general aviation facilities for the entire state. Such action eliminated all but the last alternative - developing the present site to its maximum potential. As noted previously, this resulted in 12 scheme layouts, of which three were suggested by the FAA, two by RDUAA, six by the consultant, and one by the airlines. The five acceptable plans plus the now defunct Plan A appear in Figure 1.

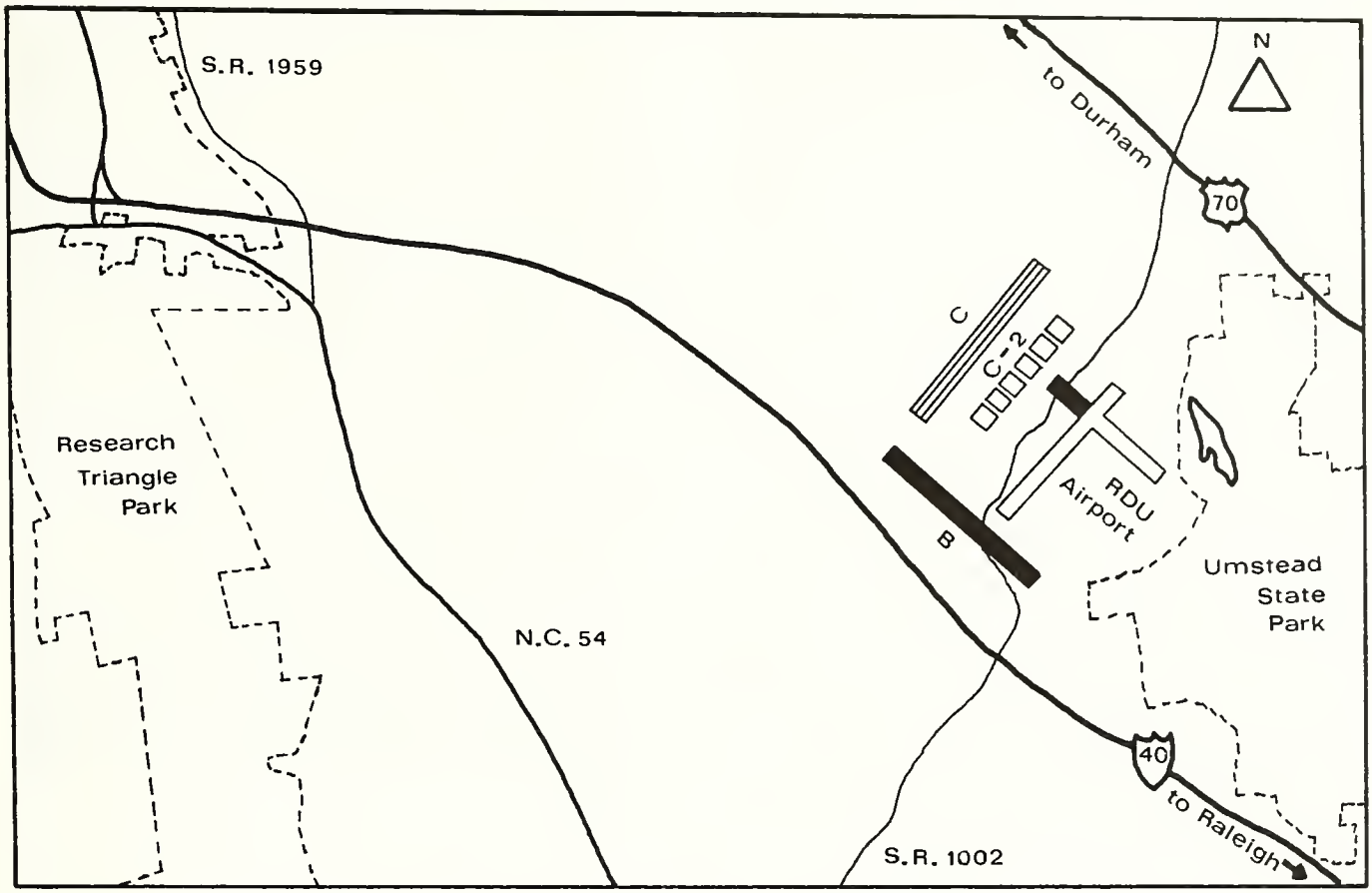
Fig. 1

PLAN A: Runway 5R-23L, the existing 7500-foot runway, would be rebuilt. A new 10,000-foot runway, 5L-23R, would be built 5000 feet southeast of the existing 7500-foot runway. Runway 14-32 would be lengthened from 4500 feet to 6500 feet. (This is the plan that was rejected in 1968 because it required a land exchange with Umstead Park.)

PLAN B: The existing 7500-foot runway would be rebuilt. Existing runway 32R-14L would be lengthened to 6500 feet. A new 10,000-foot runway, 32L-14R, would be constructed. New terminal facilities would be required. (This is the plan supported by the RDUAA.)

PLAN C: A new 10,000-foot runway, 5L-23R, would be developed 5000 feet northwest and parallel to runway 5-23. Runway 5R-23L, 7500 feet, would be rebuilt. Runway 32R-14L would be lengthened to 6500 feet. Terminal facilities would be similar to the ones above. This alternative requires the most fill, would remove the greatest amount of vegetation, has the greatest erosion hazard, and incurs the greatest cost. Runway layouts would expose more residents to noise levels of 30 NEF than any other plan.

PLAN C-1 Runway 5R-23L would be the same as in Plan C. Runway 5L-23R of 10,000 feet would be re-oriented slightly from C in order to reduce the land-fill requirements. This layout would lengthen the glide approach paths which, in turn, would require the airport to buy more land, including added industrial and residential property, one motel, and two cemetaries.



Map showing layout of existing runway and alternatives B, C, and C-2.

PLAN C-2: Runway 5R-23L would be rebuilt and lengthened 750 feet for a new length of 8,250 feet. A new runway designed to serve general aviation (private) operations would be constructed at a length of 6000 feet. This runway, 5L-23R, would be 1000 feet closer to 5R-23L than in C. Although it could serve as a backup runway, future expansion would be limited. (This plan is supported by the airlines.)

PLAN D: Runway 5-23 would be rebuilt and a 2500-foot addition would be made to give it a 10,000-foot length. This is the do-nothing alternative as it represents the minimum action required to meet FAA safety requirements. Such activity work would require the airport to be closed for an indefinite period of time. However, even the rebuilding would not allow the airport to service the predicted demand increases.

Only total project costs are available for the alternatives. Detailed cost figures are provided only for Plan B. For this reason, detailed estimation of costs for the other alternatives is not possible. No figures for various runway configurations mentioned in the above plans are given. Accepting this limitation, speculation about benefits and costs for the other alternatives is the only method left for comparison.

effects of the alternative plans

The lack of precise information for the schemes not supported by RDUAA make it difficult to analyze and compare the alternatives. The Master Plan presented to various groups and displayed at public hearings contained detailed estimates for Plan B alone. Research by the author eventually resulted in more detailed figures. These findings are outlined below.

Amount/Cost of Land to be Acquired: No costs are provided except for Plan B. This is critical since the land costs vary depending on where and from whom it is purchased. However, the amount purchased under each alternative is listed, and a rough comparison of costs might be deduced from this.

Operational and Safety Feasibility: This criterion provides no basis of comparison since all alternatives had to meet FAA specified minimum requirements.

Development Costs: As indicated, there are no detailed cost figures except for Plan B. Apparently RDUAA made these calculations although they are

not included in the Master Plan. One can assume that the minimum cost of each alternative's terminal facilities is the same. Table 1 presents the construction and variable costs associated with each alternative (land required, fill, homes displaced, etc.).

Some question might be raised about the preceeding cost figures. A more exact estimate appears in the following (Table 2) which examines each component of the various alternatives. Note that all plans are cheaper except B. The new table indicates C-2 could cost up to $17,000,000 less than the figure given to the *Raleigh News and Observer.*

Environmental Impacts: Air pollution estimates for 1980 indicate no real advantage for any one alternative although all fall below the 1975 levels due to expected future restrictions on aircraft engines. Likewise, estimates for 1995 again reveal no actual advantage for any alternative.

With design controls taken into account, the impact of the various alternatives on local water quality is also seen as minimal. All projects would provide erosion controls and be designed to minimize petroleum waste and stormwater runoff. Costs were not given for the control systems under each alternative, thus no real advantage is apparent for any plan.[15] It should be pointed out, however, that Plan C-2's costs would be $5,000,000 greater than the others because its 6000 foot runway would cause the airport sewage treatment plant to be relocated.

Noise measurements for the various alternatives were based on what is known as the Noise Exposure Forecast (NEF) system. NEF levels are calculated from aircraft noise expressed in EPNdb (effective perceived noise measured in decibels) together with the number of operations occurring during daytime and night-time periods.[16]

The FAA has published guidelines indicating land-use activities which are compatible with the various NEF levels. Within the NEF 30-40 range, activities where uninterrupted communication is essential should consider sound in design. Generally, residential development is not considered a suitable use, although multi-family developments where sound control features have been incorporated might be considered. Open-air activities and outdoor living will be "affected" by aircraft sound. The construction of auditoriums, schools, churches, hospitals, and theaters is not recommended in this zone.

At or above the NEF 40 range, FAA guidelines urge that land be reserved for activities that can tolerate a high level of sound exposure such as some agricultural, industrial, and commercial uses. No residential developments of any type are recommended. Sound sensitive activities such as schools, offices hospitals, churches, and the like should not be constructed in this area if at all possible.

Table 1

COST OVERVIEW AND REQUIREMENTS

	$ Cost (1973) X 10^6 [(a)]	Environmental Consequences [(b)]			
		Land in acres	fill requirements in cubic yards	selective clearing required in acres	buildings (all types) exposed to NEF 40 or higher contours
PLAN A	105	1595	11,006,000	309	not given
PLAN B	100	1929	17,073,000	333	62
PLAN C	117	1923	23,022,924	294	11
PLAN C-1	120	2245	15,483,694	488	11
PLAN C-2*	110	760	13,367,100		00
PLAN D	75	545	3,280,000	36	00

(a) Cost figures were taken from a *Raleigh News and Observer* article dated 2/20/76. There is some question as to whether these numbers represent the total cost or just the construction cost. A telephone conversation with the newspaper reporter, Rick Nichols, and the Airport Director, Henry Boyd (4/20/76), failed to clarify this. Costs include each environmental consequence listed except the NEF contours.

(b) Air pollution was minimal for each alternative and not included (see *RDU Airport Master Plan. Environmental Impact Assessment Report*, p. 67, pp. 99-104). Stormwater runoff values are also minimal and not listed (same as above, p. 92).

*Except for cost, all figures are taken from the Greiner Engineering Sciences' report, *Analysis for the FAA of a Runway Orientation Scheme Proposed by the ATA,* May, 1975.

NOTE: Unless otherwise documented, all figures appear in the *Raleigh-Durham Airport Master Plan. Environmental Impact Assessment Report.*

Table 3 gives project alternatives and the number of residences or institutions that are within NEF 30-40 contour range. The effect of a given NEF level on surrounding land has been previously noted.

These measurements indicate that while Plan B subjects fewer residences to a combined NEF 30-40 contour, it subjects more to the higher noise level than the four other alternatives combined. There is a significant increase in noise between these two contours since the NEF scale is logarithmic. In fact, the NEF chart suggest that no residential construction be allowed in an area exposed to more than 30 NEF. The Master Plan does not mention damage payments due to noise, but it would seem to be RDUAA's responsibility to offer some compensation to these homeowners if Plan B is approved. It should be noted that Plan C-2 was not submitted in time to be considered in the *Environmental Impact Assessment Report*. However, given its similar but smaller scale relative to Plan D, smaller NEF contours could be expected.

Land Use Compatibility: The principle measurement used in determining land-use compatibility was the number of homes and/or institutions that

Table 2

COSTS DERIVED USING
COMPONENT ESTIMATION*

(1973 Million Dollars)

	Plan A	Plan B	Plan C	Plan C-1	Plan C-2	Plan D
Embankment	14	22	29	19.7	17	4.2
Airfield	22	22	22	22	13	10
Land	3.5	4	5	6	2	1.5
Roads	2	4	4	4	2	2
Drainage Structure/ Miscellaneous Costs	0	1	0	0	5	0
Terminal	30.2	30.2	30.2	30.2	30.2	30.2
Power Line Relocation	0	0	2	2	0	0
Sub total	71.7	83.2	92.2	83.9	69.2	47.9
Contingencies, Engineering, Administration	15.8	18.3	20.3	18.5	15.2	10.5
TOTAL	87.5	101.5	112.5	102.4	84.4	58.4

*These are the author's estimates as derived from the *RDU Airport Master Plan* and the Greiner Engineering Sciences' *Analysis for the FAA of a Runway Orientation Scheme Proposed by the ATA.*

(1) The cost here is $1.27/cubic yard of fill versus .75/cubic yard used in earlier estimated.

(2) Costs assumed equal except for C-2 and D which have less extensive runways.

(3) All schemes have the same terminal requirements.

(4) Allows for a 22% underestimate of project costs.

(5) Does not include possible relocation of eight industries.

(6) Does not include cost noted in (5) and two taxiways @ $1,000,000 each.

would have to be acquired by RDUAA in order to implement each alternative plan. These figures are summarized in Table 4.[17]

Table 4

PLAN	RESIDENCES	BUSINESSES	CHURCHES
A	2	0	0
B	18	2	0
C	13	7	0
C-1	47	8	1
C-2	not given	not given	not given
D	0	0	0

Airport Access: No figures for road relocation exist except for those previously noted. Total road relocation and access costs for B in 1973 dollars are $5,065,340.[18] Although the roads to be relocated or improved for each alternative are developed, no specific costs are presented except for Plans B and C-2.

questions on the airport plan

Following is a series of questions addressing the most serious shortcomings of RDUAA's support for Plan B.

Are the NEF forecasts accurate? It appears that they are technically correct, although the contours for Plan B are distorted. Forecasts show takeoffs occurring on the 10,000 foot runway **away** from Umstead Park (toward Durham). Landings would take place from the opposite direction bringing aircraft in over Umstead Park. Under normal conditions greater noise levels occur on takeoff than on landing. However, if these landing patterns were reversed, the Park area would be subjected to substantially higher noise levels. It is very difficult to justify the expense of the 10,000 foot runway if planes are only allowed to takeoff and land in specified directions. It appears more likely that no such restriction would be imposed with subsequently higher NEF levels occurring over the Park.
Another possible bias is found in the NEF contour measurement itself. Under the NEF system, noise levels are arrived at by averaging the highest peak frequencies recorded during both a day and night period, a practical approach for most large airports where flights occur around the clock. At Raleigh-Durham, however, most of the flights occur only during daylight hours. Thus, when the lower nighttime figures are averaged with the daylight operations, a much lower noise contour is indicated than would appear under other measurement systems. Considering the fact that those facilities most seriously affected by the proposed expansion (Research Triangle Park and Umstead State Park) operate only during the day, the NEF contour measurement system does not give an accurate indication of the annoyance one is likely to experience.

Courtesy of *Raleigh News and Observer.*

Existing terminal facilities at RDU cannot handle the expected increase in passenger use

Table 3

PLAN	NEF 30	NEF 40
A	not given	not given
B[19]	44 homes, 1 church	61 homes, 1 church
C[20]	208 homes, 2 churches	11 homes
C-1[21]	228 homes, 2 churches	11 homes
C-2	not given	not given
D[22]	258 homes, 2 churches	no exposure

Why are no projects costs given for the alternatives? This appears to be in keeping with FAA policy which only requires cost documentation for the endorsed plan. No specific statement explaining this policy was found. However, the policy for developing environmental impact statements allows only detailed evaluation for the proposed plan.[23] Supposedly, time and cost factors would preclude extensive documentation for each alternative, although this is what is required for accurate and objective judgments.

Did the public hearing afford the opportunity for adequate public input? Apparently, the Airport Authority revealed very little about the expansion schemes except Plan B. As evidenced by the sample survey, the Northwest Community Task Force felt there was inadequate citizen input due to a lack of knowledge about the hearings.[24] Excessive and incomplete data were also cited as contributing to the frustration and confusion of trying to interpret the airport's Master Plan.[25] It was noted that the local planning agencies and public libraries given data by RDUAA did not have a copy of the Financial Plan which is crucial in understanding the overall proposal. Citizens felt the Airport Authority merely went through the motions of conducting a public hearing, "complying with the *form* of public hearing requirements set out in FAA regulations - on a plan to which the Authority was already committed."[26] In addition, the chairman of the hearing only allowed each speaker five minutes, and even then the remarks had to be limited to Plan B alone.[27]

Are there inherent biases in the Environmental Impact Statement (the same firm that prepared the physical plan recommending Plan B was employed to examine its environmental impact)? This possibility does exist and cannot be excluded. It appears very unlikely that the same firm recommending a specific plan would find fault with it in a subsequent report. Although the FAA has no guidelines which prevent this from happening, it is obvious that the final statement would appear more valid if a disinterested third party were to carry out the evaluation.

How much consideration was given to relocating the general aviation sector to another facility? This course of action was acknowleged by the Airport Authority, but it does not appear to have been given much serious thought. In fact, RDUAA played down the role of general aviation in future airport forecasts. For example, consider future airport operations (Table 5).[29]

The present facilities are said to be operating at maximum capacity now, which is 192,300 operations/yr. Looking at the last column below would seem to indicate the general aviation sector constitutes a large majority of the airport's operation. In fact, if the general aviation portion of the airport's operations could be completely eliminated, there would be no need for any new runways.

" . . . (I)t is obvious that the final (environmental impact) statement would appear more valid if a disinterested third party were to carry out the evaluation"

Does Plan C-2 offer any cost advantages over Plan B? It appears that Plan C-2 could be up to $17,000,000 cheaper than B. Its shorter runways provide adequate and efficient service for both commercial and private aircraft. This means less maintenance, land, and land fill costs than B. Safety is also improved by placing general aviation operations on one runway and commercial flights on another. It should be mentioned that RDUAA has developed a modified Plan B which incorporates the same features presented by C-2. Such a plan would give B lower costs.[30] However, the FAA has evaluated both of these modified plans and feels neither represents good planning.[31]

What is the justification for the 10,000 foot runway required in the other alternatives, and can C-2's shorter (8,250 foot) length provide adequate ser-

Table 5

YEAR	AIR CARRIER OPERATIONS	GENERAL AVIATION OPERATIONS	MILITARY OPERATIONS	TOTAL	TOTAL without general aviation operations
1975	40,200	138,100	14,000	192,300	54,200
1980	47,400	189,700	14,000	251,100	61,400
1985	55,000	254,200	14,000	323,200	69,000
1990	65,800	327,100	14,000	406,900	79,000
1995	70,800	365,200	14,000	450,000	84,800

The need for expanded facilities at RDU is largely the result of increasing general aviation activities
Courtesy of *Raleigh News and Observer.*

vice? Originally, the 10,000 foot runway was justified by consultants who described the need as based on future enplanement forecasts. RDU was projected to have substantial increases in long distance flights to the Midwest and West coast. These flights would require longer and stronger runways of up to 10,000 feet in order to compensate for heavier aircraft weights due to added fuel requirements. It now appears that C-2's length would offer more than adequate service since the new generation of wide-bodied jets require less takeoff distance than existing models. The Air Transport Association of America (ATA) which supports C-2, has argued that RDUAA is trying to cope with general aviation increases by developing a top of the line runway for long-haul carriers. The Association further states that commercial flights are not expected to increase significantly in the next 25 years into RDU and that general aviation operations have more modest requirements.

Table 5 clearly shows that if general aviation operations were removed from the main runway (as C-2 suggests), the existing facility would be adequate for the period through 1995. Although ATA acknowledges that the main runway would have to rebuilt and lengthened, it makes a good argument for eliminating B's 10,000 foot strip. By forcing private planes onto a new 6500 foot runway, C-2 would eliminate congestion and promote safety simultaneously. On the other hand, B overbuilds for the projected demand by providing a 10,000 foot runway which is unnecessarily long, and two secondary runways of 7500 and 6500 feet which (when combined) are excessive for the demands presented by the general aviation sector.

RDUAA has accepted the idea that the best way to maximize the development of the present site is to provide a 10,000 foot runway for the occassional (only several times a year) West Coast or European charter flight. As ATA noted, these are the only flights that would require such a long runway, and all other commercial flights could be accommodated on the shorter and less costly main runway of C-2. It seems difficult to believe that B's higher cost can be justified simply by RDUAA's desire to offer a more complete but seldom used service.

What type of NEF contours does C-2 have? The contours would be similar to Plan D.[32] NEF contours 30 and 40 would be extended slightly on the southwestern end of runway 5R-23L due to the 750 foot addition. More importantly, runway 5L-23R would be shortened from C's 10,000 feet to 6000 feet, and would be moved closer to 5R-23L by 1000 feet. Both of these factors would substantially reduce the noise produced. In addition, since runway 5L-23R would only be used for general aviation operations, one could expect the noise levels above the 30 NEF range would not be generated.
Although the Airport Authority suggests that C-2 would have twice the noise impact of B, it gives no indication what NEF levels would be experienced. It should be noted that since C-2 is siimlar to D in its NEF contours, no home or business would experience the very loud 40 NEF level generated by Plan B.

How accurate are the total cost figures? The new 1973 construction cost figure for Plan B was $101,-000,000. Assuming an inflation rate of 8%/year for each year since then, Plan B would now cost approximately $126,000,000. The accuracy of the other figures is difficult to ascertain given variable land and fill costs which are not documented in the Master Plan. There is also the problem of social costs which have not been documented. How does one transform the higher noise levels of *B* into monetary losses? Is there some method for estimating the number and cost of law suits which might be forthcoming from property owners (public and private)? These considerations were not made by RDUAA and can only be estimated in relative terms.

conclusions

A few conclusions can summarize the findings of this article:

1. The RDUAA has not maintained close contact with the public. Until it does so, it must expect continued conflicts.
2. The Airport Authority should adopt an attitude that appears more open and willing to accept criticisms and suggestions. A refusal to do so will result in another failure like the one in 1968.

3. The above might best be achieved by allowing some of the community groups to participate more directly in airport plans and decisions.
4. The FAA needs to be urged to alter its public hearing policy so as not to present a closed mind to various alternatives. The existing format allows the Airport Authority to make its choice in the absence of citizen input.
5. FAA guidelines should be developed which prevent one consultant from preparing more than one part of an airport master plan. This could help eliminate possible conflicts of interest.
6. The NEF contour approach to noise measurement does not seem particularly suited to the case at hand. An average of daytime and nighttime noise levels tends to result in a value which underestimates actual noise levels during the most critical part of RDUAA's operational activity (daytime). Such an underestimate could have serious consequences for the Research Triangle Park as well as Umstead State Park.
7. Detailed financial estimates should be required for each alternative rather than only for the one the Airport Authority is endorsing. Comparisons are difficult and almost impossible without this information. This requirement should be developed regardless of the FAA's policy.
8. Sufficient information has not been provided to determine which alternative is best. No action should be taken until this information becomes available. It does appear that Plan B, which is being offered as the 'best' alternative by RDUAA, would tend to lose any advantages it might now have when more complete data is available.

Using the data that is available suggests that C-2 might be a 'better' alternative than B for several reasons. The cost section of the paper noted that although Plan B is being called the least-cost alternative, Plan C-2 is clearly less expensive. The higher noise levels associated with B have been noted. The question of runway lengths seem to imply that C-2's shorter, cheaper, and totally adequate runway is to be preferred to B's more costly and noisy 10,000 foot structure. Similarly, the 6000 foot general aviation runway offered by C-2 appears to present an added safety feature in separating commercial and private aircraft. Whether or not this runway could serve as a back-up for the main commercial strip was not answered.

A basic policy question appears to be the real issue. Does the Raleigh-Durham Airport need a facility which would seldom be used with respect to its designed potential (Plan B), or is a more modest, but totally adequate alternative (Plan C-2) the answer? Although complete documentation is lacking, the author's research suggests that C-2 offers the best solution at this time.

The conflict which has developed over the alternate to be selected seems to be tied to RDUAA's insistence on supporting Plan B. Notes from the public hearings have suggested that Plan B was more or less selected prior to these meetings. Subsequent papers and reports have attempted to discredit the other alternatives and embellish B. Such a policy seems destined for more conflict, and the final result can only be a voter rejection of any referendum designed to help implement Plan B.

Footnotes

[1]*Durham Herald Sun*, February 22, 1942.
[2]*Raleigh News and Observer*, October 27, 1968.
[3]Ibid., November 7, 1968.
[4]Ibid., April 25, 1970.
[5]Ibid., June 14, 1970.
[6]*Raleigh-Durham Airport Master Plan. Environmental Impact Assessment Report*, prepared by J.E. Greiner Co., Inc., March, 1974, p. 10 (hereinafter referred to as *E.I.A. Report).*
[7]Ibid., p. 6.
[8]Ibid., p. 7.
[9]Ibid., p. 6.
[10]*Raleigh-Durham Airport Master Plan. Financial Development Plan*, prepared by Landrum and Brown, October, 1974, p. 24 (hereinafter referred to as *Financial Plan*).
[11]Ibid., p. 42.
[12]*Raleigh-Durham Airport Master Plan. Interim Final Physical/Technical Development Plan*, prepared by Greiner Engineering Sciences, Inc., October, 1974, p. F-2 (hereinafter referred to as *Physical Plan*).
[13]Ibid.
[14]Ibid.
[15]*E.I.A. Report*, p. 93.
[16]Letter to Regional Directors, Section E, Noise Impact Assessment in *Airports Environmental Seminar* conducted in Washington, D.C., May 8, 1975, by the FAA, p. 4 (hereinafter referred to as *Seminar*).
[17]*E.I.A. Report*, pp. 107-108.
[18]Ibid., p. 135.
[19]Ibid.
[20]Ibid.
[21]Ibid., p. 137.
[22]*Physical Plan*, p. J-7.
[23]*Seminar*, Section C, Guidelines for Organization and/or Review of Environmental Documentation, p. 2.
[24]*Community Report*, p. 30.
[25]Ibid., p. 3.
[26]Ibid., p. 7.
[27]Ibid., p. 11.
[28]*Financial Plan*, p. 42.
[29]*Physical Plan*, p. H-2.
[30]*Raleigh-Durham Airport Authority. Analysis for the Federal Aviation Administration of a Runway Orientation Scheme Proposed by the Air Transport Association of America*, prepared by Greiner Engineering Sciences, Inc., May, 1975, p. 14.
[31]Ibid., p. 12.
[32]Ibid., p. 8.

planning at the grass roots level: the guilford county citizen participation program

Historically, local governments in this country have focused their programs and priorities almost exclusively on urban areas, where population, resources, and problems are most concentrated. Rural dwellers, by contrast, have been avoided by planners and other officials, their needs being left to such rural-oriented agencies as the Agricultural Extension Service. In the late summer of 1973, Guilford County Government and its citizens broke that tradition. Stimulated primarily by the need to dampen citizen dissatisfaction with land use regulations, the County Government set out to organize the citizens of its rural and suburban areas around community defined issues and problems. What has resulted is a community organization directly involving the citizens of Guilford County. Among their accomplishments to date have been the formation of a summer recreation program, a rural garbage collection study, a rural-suburban land use committee, and a citizen's budget committee.

"The 1969 program was sponsored by those government bodies most affected by rural dissatisfaction with land use controls."

Prior to this effort, "citizen input" into the planning process of Guilford County came only through such conventional arrangements as public hearings on specific proposals, routine board or commission meetings, political representation, or the electoral process. As it was implemented in 1973, the "Community Councils Program" was a significant departure from this norm, because, one, it was non-urban in focus; two, its base was grass-roots community organization rather than individually oriented; and three, it attempted to involve organized county residents early in the planning stages of both short and long-range governmental decisions. Moreover, as a form of decentralization of political power toward the "county-wide" community and toward the local communities, its conceptualization and practice were a far cry from the rubber-stamp public hearing, the hand-picked board or commission, or the infrequent ritual of selecting remote decision-makers through the electoral process.

origins

As early as 1969, the county was engaged in a public information program to counteract rural opposition to zoning and subdivision regulations. This effort led to the alliance of governmental officials who later sponsored the 1973 program. Since the 1969 initiative was much more conservative than its successor, a brief examination of its features may provide the basis for an evaluation of the conceptual growth that eventually made the 1973 program possible.

The 1969 program was sponsored by those governmental bodies most affected by rural dissatisfaction with land use controls. Planners and inspectors on one hand, were motivated by a desire to convince the public of the benevolence of land use controls in order to dampen the hostility that frequently impeded the course of their routine duties. Commissioners, whose public meetings were sometimes disrupted by angry rural citizens demanding repeal of zoning and subdivision regulations, wanted political peace restored. The Agricultural Extension Service sought to prevent rural discontent from expanding into a general hostility against county government, which could conceivably threaten the standing of the Extension program among its traditional clientele. All these officials were convinced that the controversial regulations were in the public interest and should be maintained.

Essentially, the program consisted of a series of

Charles F. Price is on the staff of Linton & Company, Inc., Resource Management Consultants, Washington, D.C. As Assistant Director and later Director of Planning in Guilford County, he helped coordinate the citizen participation program described in the article. Price received a Master of Public Administration in May, 1976, from the University of North Carolina, Chapel Hill.

special "educational" citizens' meetings held under the aegis of the Extension Agent, who, it was presumed, still retained the trust of rural citizens and could convincingly claim neutrality in the controversy. Officials lectured the public on the benefits of zoning and subdivision regulations and attempted to win their support for them. This approach appeared to be successful (rural opposition did recede slightly after the meetings), and thereafter, county officials tended to perceive citizen participation in terms of educational output from government to citizens, tailored to serve governmental objectives.

Thus, in 1971, when the Planning Department included a citizen participation element in its 701 Comprehensive Planning Assistance work program, the primary intention was to educate the public about planning and zoning matters. The 1971 program design, when completed, however, differed from the scheme proposed in the 701 application. Due in part to the influence of the Extension Service (the program scope was broadened) calling for sponsorship by Guilford County government as a whole. The basic notion behind the expansion was that *all* of county government - particularly those line agencies engaged in service delivery - could benefit from the opportunity to provide information to citizens. The potential usefulness of selective citizen feedback was also recognized. For instance, the Planning Department envisaged using citizen participation to solicit general ideas about long-range planning policies, but had not considered the possibility of citizen input into all phases of the comprehensive planning process (such as ordinance writing, zoning and subdivision decisions, captial programming, etc.).

Leadership training is being conducted with the help of A & T University

Courtesy of Department of Natural and Economic Resources

Still, the 1971 design was not based on community organization. Instead, it proposed the establishment of a citizens' advisory board composed partly of representatives from countywide organizations (County PTA Council, Farm Bureau, Boy and Girl Scouts Councils, NAACP, Audubon Society, the executive committees of the two major policital parties, etc.) and partly of members representing individual local communities. It was thought such a structure would yield an adequate breadth of representation through (a) the existing electoral system of the countywide organizations and their local member clubs or units; and (b) the proposed identification and selection of individual community leaders who would be capable of reflecting the viewpoints of their neighbors.

"The citizens advisory board was to function as a forum for information from county department heads, and for responses by citizens to the appropriate county officials."

The citizens' advisory board was to function as a forum for information from county department heads, and for responses by citizens to the appropriate county officials. It might also sponsor a series of informational seminars around the county on various subjects requiring exposure. The key to the success of such an approach, planners reasoned, was a commitment from county department heads to use the program for information output and to be hospitable to the response generated by the citizens' board.

This program design was endorsed by the county manager, the Board of County Commissioners, and the affected county department heads during late 1971 and early 1972. At this time the Planning Department and the Extension Service became co-sponsors, devoting staff resources to implementing the program; despite the theoretical involvement of all county line agencies.

Throughout 1972, attempts were made to launch the program as designed. Several meetings were held with representatives of countywide organizations, who expressed an interest in pursuing the program. However, it proved difficult to identify and contact the community leaders who, according to the design, were to make up the balance of the advisory board.

The dilemma of community representation caused planners and extension agents to re-think the whole program design. With the influence of the Extension Service, the emphasis soon shifted from a "countywide" advisory board to community organization throughout the county. Community organization, as a component of educationally oriented community development, was consistent with the traditional mission of the Extension Service.

Planners saw its potential for achieving representation, and moreover, their active participation.

Thus, the progam was cast into an entirely new mold. The fundamental unit of the citizen participation program would now be the Local Community Council representing the residents of the several recognizable neighborhoods and communities in rural and suburban Guilford County. Each Local Community Council would elect a representative to the countywide body, to be known as the Countywide Community Council. This group, while retaining in its membership the officials of countywide organizations as before, would now undertake to place in comprehensive perspective the issues defined at the local level. The county government officals involved in the program would advise and assist the Countywide Community Council and use it as the contact point for public information initiatives.

Overhaul of the program design had moved the focus from a countywide level to the level of the individual community. It could be foreseen that, to the extent community organization succeeded, county government would be less likely to influence its outcomes than it might have been under the original scheme. If this loss of power was perceived, none of the governmental officials viewed it as a matter of concern at the time. Perhaps they were too immersed in the mechanics of re-design to anticipate its consequences. The issue would arise at a later date, however.

Staff time devoted to re-thinking the program had left little leeway for actual implementation. The program stalled under the pressure of other responsibilities, and by early 1973 it had come to a virtual standstill.

implementation

In May of 1973 the Planning Department employed a first-year student from the Department of City and Regional Planning, University of North Carolina at Chapel Hill, as a summer intern. He was given the responsibility for reviewing the citizen participation program design, recommending changes, and devising an implementation strategy. For the first time, the program was raised from the level of an incidental responsibility of two overworked agencies to the status of a functional project with full-time, undistracted staff attention.

After conferring closely with all the governmental officials and attempting to fashion the program in such a way as to suit as many of their varied interests and desires as possible a scheme was constructed similar to the 1972 community organization plan, but with a number of important conceptual differences:

(1) Collaborative citizen-government interaction had replaced government information output and citizen response input as the most dominant potential mode of participation;
(2) Participation would be defined and practiced by the citizens themselves: Local communities should organize according to whatever structure they preferred, should choose their own areas of interest, and should act publicly as they felt appropriate;
(3) The role of county government should be confined to promoting and facilitating the concept of meaningful participation, responding to citizen desires revealed by the process, and utilizing the process for collaborative public decision-making and information output.

These features were not so much explicit in the new program design as they were inevitably derivative from the strategy proposed to be employed in the organizing process. In this sense it might be said that planners had a hidden agenda for the establishment of a much more open participatory arrangement than some of the other governmental officials might have preferred to see.

"Thus the program was cast into an entirely new mold. The fundamental unit of the citizen participation program would now be the Local Community Council representing the residents of the several recognizable neighborhoods and communities in rural and suburban Guilford County."

Yet this agenda was not so hidden as to be indistinguishable. Other governmental officials, notably the county manager, not only perceived it but seemed to concur. The Board of County Commissioners seemed attracted to three principal features of the program: (a) its potential for increasing their voter appeal through an appearance of governmental responsiveness; (b) its potential for dispersing responsibility for controversial decision-making; and (c) its potential for testing the public pulse. Neither then nor later did they protest seriously against loss of political power, even when the participatory arrangement they had sanctioned in fact demonstrated its ability to change the course of public policy. Only the Extension Service expressed doubts about the openness of the proposed program, but the argument was not pressed.

The avowed purposes of the 1973 program are fourfold:

(1) To provide a means for continuing free and open communication between county government and the citizenry;
(2) To involve citizens in public decision-making;
(3) To provide a community-based organizational structure that would allow citizens to examine and address their local problems or call them to the attention of the appropriate local government agency; and
(4) To establish a representative citizen organization at the county level (the old Countywide Council, now called the Rural-Suburban Community Council) to provide a participation

vehicle for issues of countywide concern.

If few of the governmental officials could embrace this whole array of stated objectives, all of them could feel comfortable with at least one or two: therefore, a balance of interests was achieved. Perhaps for this reason, disputes over the various "agendas" were rare except on the part of the Extension Service, which remained suspicious of the collaborative interaction feature and its potential for conflict.

At midsummer, after completion of the program design, a slide-tape show was prepared by the intern and the planning staff, with the assistance of the Extension Service. It explained the program structure, the benefits and opportunities of community organization, and the commitment of the county government to responsiveness. The presentation was to be used in the field during the community organization process. With the approval of the program design and slide-tape show by Commissioners in late summer, implementation was at hand.

A basic issue - geographical coverage - had been resolved as early as 1971: The citizen participation effort, at least initially, would be aimed at Guilford County citizens who resided outside the corporate limits of municipalities. While the city officials of Greensboro, High Point, Jamestown and Gibsonville would be informed of the program and perhaps even become involved on specific matters of intergovernmental relations raised by the citizens, the county would not engage in community organization within the cities. Although county government provided health and welfare services to municipal residents and collected taxes from them, it was thought the bulk of the issues concerning city residents lay within the jurisdiction of their municipal governments. Furthermore, the intergovernmental complications inevitably arising from county-sponsored citizen action in cities could easily be foreseen. Despite this decision, the program design was sufficiently open-ended to permit eventual participation by city residents when circumstances might require their input. Indeed, within a year a Local Community Council was organized whose membership included both city and county residents.

Guilford County has strongly encouraged its rural residents to participate in the planning process

Courtesy of the Soil Conservation Service

"The citizen participation effort, at least initially, would be aimed at Guilford County citizens who reside outside the corporate limits of municipalities."

At the outset, however, the program was confined to the unincorporated area of Guilford County (approximately 500 square miles) and its 81,000 people. The goal was to provide a representative organizational structure for everyone in rural and suburban Guilford County.

operation

To convey an accurate idea of how target communities were selected and approached, it is useful to review the operation of the community organization phase.

A number of rural communities could be readily identified by virtue of physical and historical identity. With the assistance of Extension agents, planners could also define other less immediately visible communities on the basis of social or economic identity. This process was largely subjective and perceptual: Adjustments would be made later, when, in the early stages of organization, the citizens themselves would define community boundaries through cognitive mapping.

The initial organizing effort was made in a well-defined residential community of Pleasant Garden in southern Guilford County. One year later there were eight organized communities, and as of March, 1976, there were fifteen. It is anticipated that, when the organizing process is completed, the program will involve twenty-two communities.

During the fall of 1973 the Mental Health Division of the County Health Department became the third governmental co-sponsor of the program. This commitment, prompted by citizen participation requirements of federal funding for mental health, resulted in the addition of a Mental Health staff person to community organization. Also, the Extension Service provided a part-time staffer to supervise the preparation, printing, and distribution of a monthly newsletter which was circulated among all Local Community Councils and governmental actors.

By early 1974, the program, while proceeding satisfactorily in the field, had begun to encounter administrative difficulties. Only the Planning Department's coordinator was assigned to the program full-time. The Mental Health staffer, while physically located in the Planning Department, was paid by Mental Health and owed that department a percentage of time for other duties. The newsletter was, as we have seen, a function of the Extension Service. Thus, no responsible county official had the whole scope of the program under his span of supervision. While salary costs were known, operating expenses could not be tracked since expenditures for reproduction, typing, and supplies were charged to the regular operating budgets of the three departments. Though it was estimated in mid-1974 that the program was costing $30,000 a year, no one knew the actual cost. Such circumstances precluded effective management and program evaluation; they also provided an opportunity for friction between the administrators of the three sponsoring agencies.

The Mental Health Center shared the Planning Department's interest in maintaining an open, collaborative citizen participation arrangement. But the Extension Service, which viewed participation as a more controlled mechanism for citizen education, community development, and leadership training, had become increasingly uncomfortable with the notion of "citizen power" implicit in the program operation. This dissatisfaction grew sufficiently strong to threaten the unity of program sponsorship.

The Planning Director had been convinced from the outset that the program belonged under the immediate supervision of the county manager, who alone had administrative authority over all county agencies involved in its activities. The explicit concerns of the Extension Service provided an opportunity for taking the related issues of program philosophy and administration to the manager for resolution. After a period of study, the program was transferred to the Guilford County Administration in early 1975. It will be remembered that the participatory concept espoused by the county manager was one of openness and citizen power.

Space limitations prevent a comprehensive accounting of all activities undertaken by the citizens of Guilford County since the inception of the Community Councils Program. However, it is possible to list some of the major initiatives sponsored by the Rural-Suburban Community Council which will reflect the countywide perspective achieved by the program:[1]

(1) The 1974 Recreation Pilot Program - This effort featured citizen committees in each Local Community Council area which identified program and equipment needs, set priorities for program planning and equipment purchase, and took a hand in personnel selection.

(2) The Ad Hoc Study Commission on Recreation - Recommended by the Rural-Suburban Community Council and appointed by county commissioners, this body conducted public meetings in the four quadrants of unincorporated Guilford County to examine recreation needs and circulated questionnaires with the help of the Community Councils Program staff.

(3) The 1975 Summer Recreation Program - This program, a direct outgrowth of the initiatives outlined above, will involve 25 playground sites and $80,000 (three times as many sites and five times as much money as the 1974 pilot program) and will again utilize the Local Community Councils for program design.

(4) The Rural Garbage Collection Study - The Rural-Suburban Community Council administered preparation and distribution of a questionnaire designed to identify citizen needs in rural garbage collection.

(5) The Rural-Suburban Dialogue - This effort, funded by a grant from the North Carolina Committee on Continuing Education in the Humanities, resulted in a seven-week series of community meetings designed to explore the topic of public education. Dialogues were planned by a steering committee made up of citizens from each Local Community Council.

(6) The Education Committee - Composed of hold-overs from the Dialogue Steering Committee and volunteers who became interested in the dialogues, this committee identified county education issues and outlined strategies for improvement. This committee cooperated with the Gateways Task Force on Secondary and Elementary Education to discuss issues common to city and county schools.

Courtesy of Department of Natural and Economic Resources

The Rural-Suburban Community Council organized citizen committees to identify area recreation needs

(7) The Rural-Suburban Land Use Committee - This group engaged in collaborative exchange with the Planning Department in the revision of the Guilford County Land Use Plan. The Planning Department also visited individual Local Community Councils to solicit input. At the request of this committee, the Rural-Suburban Community Council formally asked the county for $50,000 to be used for legal aid to citizens filing suit against the county for environmental violations.

(8) The Citizen's Budget Committee - This committee, made up of interested citizens from each Local Community Council, gathered citizen input concerning needs and quality of service, assigned priorities, and influenced the county budget-making process for FY 1975-76. It had the cooperation of the county manager and budget officer.

evaluation

The community councils coordinator who, as a summer intern, fashioned and implemented the Guilford County citizen participation program, identified eight major areas of accomplishment after almost two years of operation:[2]

(1) Needs are being identified and pursued by citizens.

(2) Agencies are spending time and effort in receiving organized citizen input.

(3) Citizens are expecting to be taken into account more meaningfully.

(4) The shortcomings of elitist, closed-door planning are being recognized by citizens, with the result that they are more strongly motivated to participate.

(5) Some of the short-range needs identified by Local Community Councils are being fulfilled.

(6) Leadership training is being conducted with the help of A & T State University.

"The shortcomings of elitist, closed-door planning are being recognized by citizens, with the result that they are more strongly motivated to participate."

(7) Educational needs defined by local communities are being answered by the appropriate government officials in such areas as airport planning, social security administration, formulation of wills, budgeting, land use, mental health, drug abuse and law enforcement.

(8) Intra-community communication is being enhanced by the Community Councils Program newsletter, which now reaches approximately 1400 people.

Measured against a standard of normative perfection, this is not an instance of radical community control. But in the context of common participatory practice, especially for rural areas, the program appears legitmately collaborative. If the validity of participatory forms must be measured by the extent to which citizens *control* the public decision-making process in some direct fashion, then in fact the Guilford County program is invalid. But if, on the other hand, validity is determined by the disposition of institutions to recognize and be influenced by organized citizen opinion, then the ideal participatory mode becomes a cooperative one, in which *joint* policy-making is possible. Viewed from this perspective, the Guilford County program is potentially valid.

"...(if) validity is determined by the disposition of institutions to recognize and be influenced by organized citizen opinion, ... the Guilford County program is potentially valid."

Relinquishment of institutional and political power was implicit in the community organization scheme. Yet it can be argued that power, if unused, does not exist: The most profound test of the program's validity is the willingness of the organized citizenry to accept and use the power implicitly relinquished. If used, this power may even be increased, since the institutional and political system may now be susceptible to even further change by virtue of the uncertainty arising from the marginal power transfer it has already undergone. The relative power roles of citizens and institutions are yet to be determined, but now the initiative seems to lie with the citizens.

This viewpoint rests on the assumption that the motives of all the governmental officials engaged in the program add up to institutional responsiveness of an authentic sort. Manifestly, individual motives were and are not uniform. Yet, because of the uniquely multi-faceted character of the program's objectives, county officials have been able to perceive it in a number of ways. It serves a narrow purpose for one agency, a large purpose for another. Yet, by acknowledging the participatory process at all, they become susceptible to an increase of citizen influence, because that influence is a fundamental element of the program design. The design is such that institutional responsiveness may come about through inadvertance. The major ingredient is the aggressive and imaginative use by citizens of the power offered them by community organization.

There is evidence to suggest that elected and administrative officials of county government now regard the Community Councils Program as an influential force that must be taken into account in public decision-making of significance. The establishment of a county recreation program was a direct result of concerted citizen action; it

The fundamental unit of the citizen participation program is the Local Community Council

Courtesy of Department of Natural and Economic Resources

"Citizens have been directly involved in the land-use planning process and provided input into the FY 1975-76 county budget."

demonstrated that the Community Councils Program could in fact force the Board of County Commissioners to reverse a policy commitment. Citizens have been directly involved in the land use planning process and provided input into the FY 1975-76 county budget. Citizens are also actively engaged in strengthening their local communities and addressing their local problems. Some of these activities may be dismissed as cooptation or ritualism or neighborhood parochialism, but in at least one instance, the recreation program citizens have proved themselves capable of showing muscle on an issue that mattered.

In "selling" the community organization concept to a target citizen audience, county organizers stress the potency of a unified, representative citizen influence on institutions as opposed to random individual contacts. This is in fact an argument for political power. If consensus on a public issue can be developed within the network of Local Community Councils (as occurred with the recreation question), the Rural-Suburban Community Council can approach the Board of County Commissioners and legitimately claim to represent the sentiments of several thousand citizens on that issue. Thus, the pressure they bring to bear on decision-makers is clearly political.

The Community Councils Program can exert sufficient political power on elected officials to cause a reassessment and reversal of public policy; but it should be remembered that - once a new policy direction has been forced - the planning and implementation of programs becomes a *collaborative* process involving citizens, elected officials, and public administrators. This was the model followed in the development of the County Recreation Program, and it appears to be a practical model for citizen participation.

Footnotes

[1]Paraphrased from a letter to the writer from Rex H. Todd, Guilford County Community Councils Coordinator, dated March, 12, 1975.

[2]*Ibid.*

superfarms and the coastal environment: an in-depth look at a large-scale problem

Ever since white men have inhabited the area, the vast swampy reaches of North Carolina's Albemarle-Pamlico Peninsula have been considered a wasteland, useful only for logging and an occasional small farming venture. Over the last few years, however, great changes have been in the making for this long disregarded region. Spurred by increasing grain prices and postwar advances in farm technology, a number of large corporations have bought up vast amounts of acreage in the coastal area with the idea of conducting large-scale agricultural operations.

Whether "superfarms" on the coast are a blessing or a curse has yet to be determined. Historically, the region has been economically depressed. Attempts at small scale farming have consistently failed. Thus, large scale farm ventures are looked upon as the solution to economic woes. Further, agricultural experts view the farms as posing no serious threat to the environment but, instead, as affording a great opportunity for converting a wasteland into profitable farmland. Environmentalists, however, are worried about the possible adverse impacts on the immediate wetland area and, more importantly, on the surrounding estuaries and marshlands which provide spawning and nursery areas for shellfish and commercial fisheries.

Never before has such a large-scale farm effort been launched in so sensitive an ecosystem. Thus, virtually no information is available on its potential impact on the coastal environment. This article will examine both the natural features of the coastal area and the activities involved in setting up and operating a superfarm. Hopefully, by juxtaposing these two elements, the environmental impacts of superfarms can be predicted and the issue placed in better perspective.

recent history

Acquisition by corporations of land for superfarms first began around 1970. At present, 414,000 acres or two-thirds of the Albemarle-Pamlico peninsula have been purchased, including parts of Washington, Tyrrell, Dare, and Hyde Counties. Another superfarm of 45,000 acres has been established in northern Carteret County. The corporations involved include American Cyanamid and John Hancock Mutual Insurance which jointly purchased the 35,000-acre Mattamuskeet Farms; Shima American Corporation of Illinois, a Japanese-owned firm, which bought 7,500 acres; and Atlantic Farms, which bought about 40,000 acres. In northern Carteret, Ferruzi of Ravenna, Italy, bought 40,000 acres to start Open Grounds Farms, Inc. But the largest purchase was made by Malcolm McLean in 1973 when he bought Westvaco's holdings, Atlantic Farms and other small farms totaling over 370,000 acres to establish First Colony Farms, Inc. With the purchase of this superfarm in 1973 came the first major concern over the environmental impact of the large farming operations.

Concerned scientists have perceived that the superfarms are by no means ordinary agricultural projects. The surrounding area is largely a wilderness of swamps and bogs underlain by peaty organic soils, except for areas cleared and ditched in past farming attempts. To convert such land into fields suitable for crops, vegetation must be cleared and swamps drained. Such massive alterations cannot help but have a significant effect on such a sensitive environment.

description

The physical environment of the Albemarle-Pamlico Peninsula can be described as an almost flat terrace sloping slightly towards the sounds and estuaries at a rate of about .7 foot per mile. The highest elevation on the Peninsula is twenty feet above sea level, occurring along the western portion. However, more than two-thirds of the area is at an elevation of less than five feet above sea level.

The drainage system of the region is limited to a few short streams, found mostly in the western

Mary Joan Manley Pugh has received a Bachelor of Science in Zoology and a Master of Regional Planning from the University of North Carolina, Chapel Hill. She has worked for the North Carolina Office of Marine Affairs and the Division of Environmental Management, Department of Natural and Economic Resources.

portion, and a few large streams penetrating a small part of the interior. The four lakes in the area aid little in the drainage system since they are shallow and partially surrounded by ridges which block overland runoff.

With such a poor drainage network, the water table is very high — occurring at the surface in wetland areas. Because of the slight gradient and the high water table, runoff from the region is small and water has collected in the lower areas causing the formation of peat, (a soil composed of organic deposits). Over, time the peat has deepened enough to cover most of the Peninsula, hiding the actual variations in the underlying topography.

The soil is of two major types (1) mineral and (2) organic. Mineral soils consist of a mix of sand, silt and clay and are generally suitable for agriculture. Eighty to ninety percent of the region contains organic or peat soils consisting of organic materials mixed with small to moderate amounts of sand, silt, and clay to a maximum of twelve feet. In addition, the deep organics often contain large woody materials such as stumps and logs preserved for thousands of years by the acidity of the organic or peat soil.[1]

Peat is very acid with a pH around 4 so the pH must be raised in order to grow crops. Furthermore, fertilizer must be added to the organic soil which lacks nutrients such as phosphorus and inorganic nitrogen necessary for plant growth. Because the soil is waterlogged, the peat remains cold longer in the spring and becomes cold sooner in the fall. Thus, before the land can be farmed, the growing season must be lengthened by draining the soil.[2]

"Never before has such a large-scale farm effort been launched in so sensitive an ecosystem."

Because of the high water table and the peaty soils, the biological communities of the area consist mainly of wetlands such as bogs, wooded swamps, irregularly flooded marshes and fresh marshes. Wetland soils are often either waterlogged or covered by water during the growing season depending on the type of wetland. Marshes are the wettest areas and so support various grasses and other marsh plants. Wooded swamps are covered by water a lesser portion of the year so that hardwoods prosper in this environment. Cypress and atlantic white cedar occur in the wetter areas and gum, bay, oak, and pine are found in slightly drier sites.[3]

Bog, which consists mainly of pocosin, makes up the majority of the wetland acreage. Pocosin, an Indian term meaning "swamp on a hill," occurs in low upland flats which are the driest of the wetland portions. Pocosin requires dry periods during the summer to generate the natural fires necessary for the pond pine (its dominant tree species) to survive.[4]

The artificial drainage system greatly increases the natural drainage efficiency

Courtesy of the Soil Conservation Service

drainage system

To utilize the wetlands for agriculture the waterlogged peat must be dried. So the first and most crucial step in farming the region is lowering the water table below the root zone by means of an artificial drainage system.

Three types of ditches are generally constructed. The first type consists of main canals which connect the inland system of ditches with a stream or sound. The materials dredged from the canals are used to construct access roads along the canals. The width varies from 15 to 20 feet and the depth from 10 to 15 feet.

The second type of ditches are collector ditches which are dug perpendicular to the main canals and spaced one-half mile apart. The width varies from 10 to 15 feet and the depth from 6 to 8 feet.

Parallel to the main canals and perpendicular to the collector ditches are a third type of channel called field ditches. These are spaced from 260 to 300 feet apart depending upon the hydraulic conductivity of the soil. For instance, deep organic soils have poor hydraulic conductivity so it is necessary to place the ditches closer together to achieve maximum drainage. Field ditches are V-shaped with a width of 5 feet at the top and one foot at the bottom. The depth is usually 5 feet.

Typical dimensions of a superfarm field are one-half mile by 330 feet. The ditches provide an average of 20 miles of channels per square mile of land. This is a highly efficient system compared to the average Coastal Plain drainage density of only 1.4 miles per square mile of land. It is clear, then, that the artificial drainage system increases the efficiency of

drainage greatly.

The drainage efficiency is further increased in the process of field preparation. After six months or more, when the soil is drained enough to support farm equipment, the marketable pulpwood and sawtimber are removed and the remaining vegetation is piled in long windrows. Since the gradient is slight, the next step is to disk and shape the field so that it slopes towards the field ditches. This augments the drainage efficiency and accelerates the water movement through the system.

water

The effect of the increase in drainage efficiency is a significant change in the water budget of the region. The ditches lower the water table level from an average of one foot to four feet below the surface. This seeming slight change in water table is estimated to reduce the ground water recharge by 50 percent.

With this reduction in ground water replenishment, salt water intrusion of the lower aquifers will be accelerated. However, because such a large amount of freshwater is involved, salt water encroachment will not happen suddenly. The more immediate problem of encroachment is in the higher, more shallow aquifers especially the uppermost Quaternary deposits. Since the bottoms of the ditches are several feet below sea level, brackish water can enter and travel long distances inland depending on the rate of freshwater outflow in the ditches. This brackish water will then filter down to the Quaternary aquifers used for water supply.

Saltwater encroachment of the upper aquifers can be prevented by placing controls on the ditches to insure a constant amount of freshwater outflow. At present, however, ditch controls are being used to keep the water levels as low as possible to obtain the maximum drainage. Thus, a pathway is provided for brackish water to enter the field ditches and encroach on the shallow aquifers.

The greater efficiency of the water movement through the system will also cause an increase in the rates of water runoff to streams and estuaries. The overall annual increase in runoff is expected to be only one inch, but this masks the expected sizeable increase in the maximum runoff during storms and the minimum runoff during dry periods.

Below is a comparison of the water budget before and after drainage.

	BEFORE	AFTER
Precipitation	51.0	51.0
EvapoTranspiration	36.0	35.25
Runoff	14.5	15.5
Groundwater Recharge	0.5	0.25

The increase in surface runoff affects the surface water in two ways. Firstly, it could affect salinity patterns or the amount of saltwater content in the surrounding coastal water. Since the region's inflow of freshwater makes up only a small portion of the total, it is doubtful that the overall salinity pattern will change significantly. However, this may not hold true for small tidal streams and marshes in which the freshwater input is naturally small. A slight increase in the volume of runoff to a small stream may raise the overall percentage of total freshwater 100 or 200 per cent and thus upset the delicate balance of salinity essential to shellfish and spawning organisms.

"A slight increase in the volume of runoff to a small stream may raise the overall percentage of total freshwater by 100 or 200 percent and thus upset the delicate balance of salinity essential to shellfish and spawning organisms."

Secondly, the effect of an increase in surface water runoff could increase the turbidity of streams in the area. This increase is not thought to be significant because organic soils add little suspended solids to the water compared to mineral soils normally used in agriculture. However, estimates on a similar environment predict an increase of 12,000 tons of sediment a year, an amount never before experienced in estuarine waters. Although some estuarine waters are naturally turbid, a question still remains as to the effect of sedimentation on waters not naturally turbid.[5]

land

The major impact of drainage on peat soils is subsidence. Subsidence, or the tendency to compact and shrink, results from exposure to air and a lack of enrichment from litter deposited by natural vegetation. According to a study made by Dolman and Buol on North Carolina tidewater soils, as much as one-third of the thickness of the soil to the water table can be lost due to subsidence. The average rate in North Carolina is thought to be one inch per year. Subsidence can be minimized by maintaining a high water level in ditches, but will continue to occur regardless. Thus, the depths of the ditches will continue to be reduced exposing the woody material preserved in the acid deep peats.

Another problem in draining deep organic soils is a condition called irreversible drying. Under extremely dry conditions, usually during the summer, peat hardens into clogs which lose their hydraulic properties of holding and transmitting water. This condition can be controlled by maintaining a high water level in the ditches.[6]

The process of soil oxidation, in which the soil unites with oxygen and further subsides, can also become a problem when peat is drained. It occurs naturally in wetlands; however, the rate depends on the depth to the water table. So by draining the soil and thereby lowering the water level, the depth of

the soil to the water table is increased and the rate of oxidation is accelerated. Since the surface of the soil is more likely to be dry enough to ignite after drainage than it would naturally, the likelihood of fire is increased. The pocosin of eastern North Carolina has one of the highest potentials for generating natural fires in the world because it spans large continuous tracts containing combustible peat soil and has few natural barriers. So, an increase in the possibility of wildfires could be dangerous unless preventive measures are taken. These include shelterbelts or windbreaks to block predominantly southwesterly winds which can spread wildfires once they start.

air

Wind erosion is another possible problem. When the land is cleared and drained but not yet planted, the wind can easily carry away the fine grained surface materials. Shelterbelts, or windbreaks or, preferably, natural vegetation can reduce blowing in areas up to several times the height of the vegetation.[7]

ecosystem

The major effect of drainage on the ecosystem is to adversely alter its ability to perform valuable services such as water table maintenance, flood control, water filtration, pollutant storage and wildlife habitat.

Swamps and bogs maintain the water table naturally by recharging the groundwater or filtering water down into the deeper aquifers, especially during wet periods when stream levels are high. The effect of this vertical drainage of water is a large hydraulic head of freshwater which retards saltwater intrusion of the lower aquifers. Since ditches lower the water table and transmit the water horizontally instead of vertically, groundwater recharge is reduced and saltwater intrusion is accelerated.

The ability of swamps and bogs to control flooding downstream is altered in two ways. First,

"The major effect of drainage on the ecosystem is to adversely alter its ability to perform valuable services such as water table maintenance, flood control, water filtration, pollutant storage and wildlife habitat."

vegetation is removed so that the water entering the swamp or bog is not slowed before entering downstream areas. The result is an increase in the frequency of downstream flooding. Second, ditching reduces the ability of the soil to absorb floodwaters so that the volume of water entering downstream areas is not diminished.

Water filtration and pollutant storage is also greatly hampered by drainage and field preparation. Vegetation important in trapping and storing nutrients, pollutants and particulate matter is destroyed. Also, by ditching and grading peat soils, the effects of waterlogging that limit soil processes such as decomposition of nutrients are reversed.

Specialized tractors till the highly organic soils of the Albemarle-Pamlico peninsula
Courtesy of the Soil Conservation Service

This causes a loss in the soil's ability to store nutrients, pollutants and particulate matter and slowly release these materials to downstream estuaries. The end result is an increase in nutrients, toxic substances, sediments, and other potential pollutants that not only contaminate estuarine waters, but also increase the probability of eutrophication of estuaries (which causes a decrease in oxygen available to shellfish, spawning organisms and other animals).[8]

Drainage also affects wildlife by greatly altering their habitats. In changing the physical environment, some animals benefit but others are adversely affected. Of the terrestrial animals, the black bear and the bobcat are most affected by the fragmentation of swamps and bogs caused by drainage. These animals need large continuous tracts of swamp and bog in which to roam and will become extinct in eastern North Carolina if wetlands are destroyed or greatly modified by agriculture.

In addition, if the shores of sounds and large lakes are modified extensively, the southern bald eagle and the osprey, both endangered species, will be threatened. The red cockaded woodpecker could also become extinct if unmanaged pine forests are destroyed.

Many small game species such as rabbit, deer, quail, and muskrat stand to benefit if substantial shelterbelts are provided. However, these animals, along with such undesirable bird types as starlings and blackbirds, will be attracted to the grain crops and could cause severe crop depredation.[9]

Aquatic biota is affected the most by the increase in runoff. During heavy rains, shrimp and other spawning organisms could be swept out of upstream tidal creeks and marshes to downstream areas where the bottom is too sandy for them to survive. Also, a change in the salinity of small tidal creeks, could adversely affect oysters, other shellfish and spawning fish important to commercial fisheries.[10]

preparation for crops

In preparing the soil for crops, the first item that must be added to the soil is lime. This is needed to raise the pH of the soil from about 4 to 6 or 7 and is accomplished by mixing 6 tons of lime into the top layer of the soil every two years. The addition of lime increases the rate of subsidence of the soil by further drying it. Lime also increases the pH of the water runoff. If the runoff is not sufficiently diluted, this increase in pH could significantly inhibit the primary production of plants vital to the rest of the food web (especially in small tidal creeks and marshes).

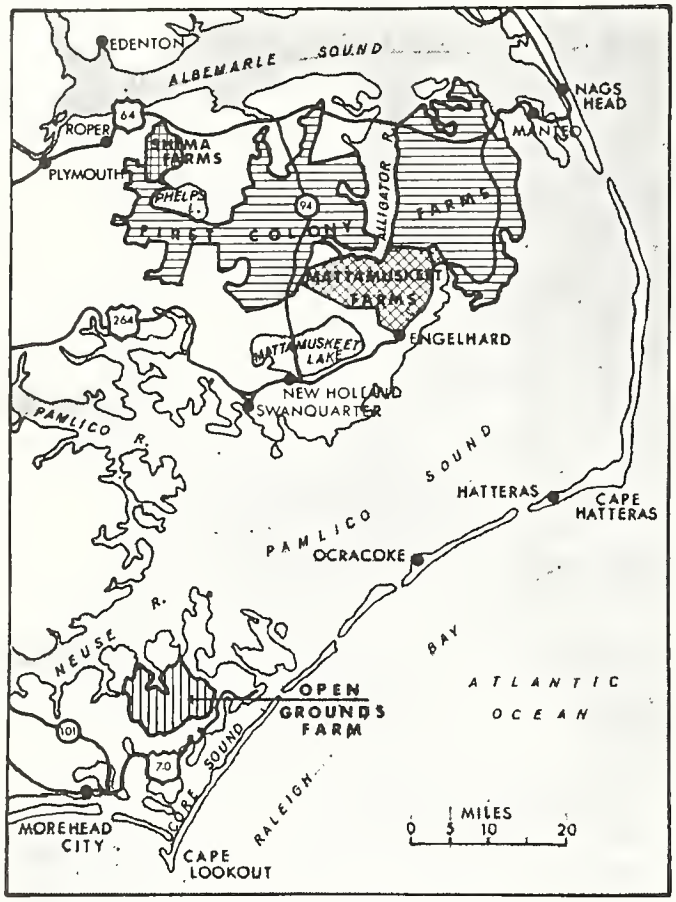
Since both mineral and organic soils are deficient in phosphorus, rock phospate must be added at a rate of 1000 pounds per acre to newly cleared organic soil. The increase in phosphorus in surrounding streams and sounds is not thought to be a problem since, according to Hobby's study in the Pamlico Sound, phosphorus is always available in amounts sufficient for an algal bloom.

Environmentalists fear that superfarms may upset the delicate ecosystem of the coastal waters

Courtesy of Department of Natural and Economic Resources

Inorganic nitrogen also must be added in spite of the abundance of organic nitrogen present in the soil. It is hoped that in the future, once drained and aerated, the soil will provide an environment in which soil microbes can denitrify organic nitrogen into inorganic nitrogen which plants can absorb. At present, however, large quantities of nitrogen (from 100 to 150 pounds per acre) are being applied.[11] Unlike phosphorus, nitrogen is a limiting factor in the eutrophication or enrichment of streams and sounds. According to Hobby, the Pamlico Sound already shows an upward trend in algal blooms indicating that it is approaching the threshold point above which it can not assimilate the incoming nitrogen increase.[12] In the Open Grounds Study, no change has been found in nitrogen concentration, but the 12,000 acres in production comprise only a fraction of the total expected acreage in production. Thus, it appears that nitrogen loads from the superfarms pose the greatest problem.[13]

To prevent disease and ward off various small pests, herbicides as well as other pesticides are being applied in large quantities to crops and pasture grasses. Most of the pesticides in use have short half-lives, from 3 to 4 days up to 6 weeks. However, if they are sprayed on the crops, pesticides could enter the field ditches and reach the estuaries before they decompose. Since estuaries are spawning and nursery grounds for fish and shellfish, pesticides entering estuarine waters threaten the survival of these organisms. Already, fish kills have



Location of superfarms in relation to the coastal area

occurred in field ditches. Furthermore, some pesticides are insoluable in water and upon reaching a stream, they sink to the bottom where filter feeders such as oysters, clams, and other shellfish can ingest them and become inedible. Because of the rapid settling rate of particulates in saltwater, pesticides could become available to filter feeders at an increased rate.

livestock operation

The livestock operation includes pastures and feedlots for cattle and sow parlors for hogs. Cattle are grazed in the pasture then transferred to feedlots for the final weeks. The hog operation, however, is more complex since the hogs are kept in houses and their wastes allowed to fall through the floor boards into pits underneath. The pits are connected and their contents pumped into a large lagoon. The proposed method of waste disposal is to place it on the land as fertilizer. However, if First Colony Farms, for example, is to achieve its goal of 25,000 500-sow units, 560 acres will be needed every year to dispose of the waste.

The major environmental concern with the livestock operation is the heavy nitrogen load it will place on the lagoons and fields. This load could be leached out of the soils into the groundwater and into the streams and lakes. This would add to the eutrophication problem in the nitrogen-limited estuaries and sounds and could degrade surface and groundwater quality.

Another concern is the percolation of bacteria from the waste in the lagoons and fields. These bacteria could leach out of the soil into the groundwater, be transmitted to estuaries and sounds and contaminate shellfish.[14]

summary

In the following chart, the effects of four possible alternative land uses on the environment will be analyzed. The first alternative is to leave the area in its natural state. In this way, the ecosystem will be allowed to perform the many valuable services it provides naturally.

The second alternative land use is managed forestry or silvaculture. This would involve draining and preparing the land for pine forest production since hardwoods are uneconomical to manage.

Agriculture with no controls or safeguards is the third alternative. This means that all the land would be drained and cleared, large quantities of lime, copper, fertilizer and pesticides would be applied and no controls would be placed on the ditches to regulate water quality and flow rates.

Controlled agriculture is the fourth alternative land use. This would involve a buffer of natural vegetation surrounding drained and cleared areas and along streams to retain functional units of ecosystem which provide valuable services, preservation of large undisrupted tracts of natural habitats for endangered species, regulation of discharge sites, water quality and flow rates so as to minimize erosion, salinity changes, nutrient enrichment, pesticide contamination and saltwater encroachment; and shelterbelts or windbreaks of natural vegetation oriented southeast by northwest to block southwesterly winds which aid in the spread of wildfires.

conclusions

Much of the research on the environmental impacts of the superfarms is in progress or proposed. Therefore, most of the information in this article is based on estimates of the effect of superfarms on the environment and should be viewed in that light. Keeping these assumptions in mind, some conclusions can be made about the environmental and economic aspects of each land use alternative.

The most environmentally sound use of the superfarm region is to leave it in its natural state to perform its various functions for the human environment for which no economic effects can be qualitively determined. The most economically efficient alternative is agriculture without any controls, but its environmental effects are the most adverse of the four. Forestry is not the best choice economically or environmentally since the rate of return is not worth the investment and the environmental effects are only slightly less adverse than uncontrolled agriculture. The best balance between economic

ALTERNATIVE LAND USES

Environmental and Economic Categories	Natural	Silvaculture	Agriculture	Controlled Agriculture
I. Water				
A. Water Budget	no change	- slight increase in overall runoff, significant increase in minimum and maximum rates of runoff - decrease in ground water recharge	- slight increase in overall runoff, significant increase in minimum and maximum rates of runoff - decrease in ground water recharge	- runoff rate is regulated - slight decrease in ground water recharge
B. Groundwater	some saltwater encroachment through deep aquifer	- increase in salt water encroachment through deep aquifer and - through shallow canals	- increase in salt water encroachment through deep aquifer and - through shallow canals	- increase in salt water encroachment through deep aquifer - control gate to prevent encroachment through canals
C. Surface water 1. Salinity	- balanced saline and fresh water	- significant decrease in salinity of small tidal creeks during rapid runoff	- same	- discharge sites chosen to minimize salinity decrease in small creeks
2. Sediments (Turbidity)	- some turbid waters and clear waters	- short term significant increase during drainage and clearing - slight increase overall	- same - increase overall	- control gates regulate water flow rate to minimize sediment runoff - slight increase overall
3. pH	- no change	- slight increase in pH caused by lime	- increase in pH caused by lime	- slight increase in pH
4. Phosphorus	- high	- slight increase	- same	- same
5. Nitrogen	- limiting factor in eutrophication	- no change	- increase in eutrophication	- control fertilizers and water flow rate to minimize but still slight increase in eutrophication
6. Pesticides	- some background	- almost no increase in pesticide contamination	- increase in pesticide contamination	- control pesticide application and water flow rates to minimize, still slight increase
7. Coliforms (Bacteria)	- some background amounts	- no change	- increase in coliforms with hog waste application	- control water flow rates still slight increase with hog waste application

Environmental and Economic Categories	Natural	Silvaculture	Agriculture	Controlled Agriculture
II. Land				
A. Soil Subsidence	-almost none	-increase during draining, clearing and liming -slight increase during production	-same -increase at decreasing rate during production	-water level kept high but still slight increase overall
B. Slow Oxidation	-some	-increase during draining, clearing and liming -slight increase during production	-significant increase during draining, clearing and liming -increase during production	-water level kept high still slight increase overall
C. Wildfires	-some	-increase overall	-significant increase in wildfires during draining, clearing and liming -increase during production	-water control to minimiz drying and wildfires, still slight increase
D. Irreversible Drying	-almost none	-almost none	-increase overall	-water control to minimiz drying but slight increas
III. Air				
A. Wind Erosion	-none	-slight increase especially during clearing	-increase especially during clearing	-shelter belts to block winds, still slight increase
B. Odor	-none	-none	-significant increase due to hogs	-locate hogs to minimize odor, still increase
C. "Wings" grain elevator	-none	-none	-no significant increase	-same
IV. Ecosystem				
A. Services				
1. Flood control	-no change	-significant decrease	-destroyed	-preserve bog surrounding crops and along streams but still a decrease
2. Water filtration	-no change	-significant decrease	-destroyed	-same as above
3. Pollutant storage	-no change	-significant decrease	-destroyed	-same as above

Environmental and Economic Categories	Natural	Silvaculture	Agriculture	Controlled Agriculture
B. Vegetation	- species diversity and stability	- replace with monoculture of pines so stability decreases significantly - long term and possibly irreversible change	- replace with monoculture of hybrid grains so stability decreases significantly - long term and possibly irreversible change	- replace with monoculture of hybrid grains but leave buffer surrounding farmland so that the decrease in diversity and stability is lessened
C. Land Wildlife	- protection of endangered species: bear, bobcat and rare birds	- significant decrease and possibly irreversible change in the protection of bear, bobcat and endangered birds	- same	- preserve areas inhabited by endangered species
	- some deer	- increase in deer	- significant increase in deer	- same
	- small fur bearing animals	- increase in small fur bearing animals	- significant increase in undesirable birds	- same
D. Aquatic Wildlife	- shellfish and fish spawning	- slight decrease in shellfish concentration and fish spawning	- significant decrease in shellfish concentration and fish spawning	- control water flow rate to minimize rate and sediments but still slight decrease in shellfish concentration and fish spawning
/. Economic Effects A. Rate of Return	?	6%		6.3%
B. Jobs	none	200	1000	1000

and environmental factors seems to be agriculture with controls and safeguards. But its rate of return is only 6.3 per cent, hardly worth the investment unless other underlying benefits are considered. These include avoiding capital gains taxes, taking a loss deduction for tax purposes, increasing the market value of the land, and obtaining additional returns from secondary facilities such as food processing plants and slaughter houses. These other benefits have to be judged in the individual cases of superfarm owners.

The choice of alternatives thus depends on the tradeoffs decision-makers are willing to make between environmental quality and economic efficiency in an economically depressed area.

Footnotes

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[11]N.C.S.U., *op. cit.*, p. 20.

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the site-value tax: its potential effect on urban and county land uses in north carolina

Of the many factors deemed responsible for the decay of our central cities, one which is consistently cited as a major problem is the property tax. It is charged with encouraging urban blight and ugliness, generating urban sprawl and the inefficient use of land, and unfairly burdening those who are least able to pay.[1] Cities and states have reacted to these problems in a piecemeal fashion, enacting various tax abatement or exemption programs when inequities and inefficiency became too onerous. But these programs are limited in their effectiveness by their lack of a systematic approach to the inherent weaknesses of the property tax system.

Often proposed as a reasonable alternative to the current property tax system is what is known as a site-value tax. Henry George, an American economist, began lauding its virtues almost one hundred years ago.[2] But in spite of the theoretical validity of arguments made by its proponents, few taxing jurisdictions have seriously considered site-value taxation as an alternative to the present system, and fewer still have implemented any form of it.[3]

Economic theorists have thoroughly explored the expected effects of the tax, but there is a dearth of research focusing on the actual assessment figures of existing taxing jurisdictions and the effect which site-value taxation would have on specific types of land uses within the community. This paper, after briefly reviewing the theoretical arguments in favor of site-value taxation, investigates the effects which a site-value taxation system would have on various land use categories in two North Carolina urban centers and their counties—Charlotte and Mecklenburg County, and Durham and Durham County.

definition of site-value taxation

Under current tax structure, the governing body assesses land and improvements to the land in it's jurisdiction. This combined value constitutes the jurisdiction's tax base. When revenue requirements are determined, the tax rate is set by dividing the tax base into the revenue requirements figure. Thus, if a county has a total of $20,000,000 worth of land and buildings, and requires $400,000 a year to provide services (assuming the property tax to be the sole basis of support), then the rate is set at 2% (400,000/20,000,000). A property owner with a $34,000 home on a $16,000 lot would pay .02 x $50,000 or $1000 in taxes.

Under a site-value tax system, only the land in the jurisdiction is appraised and its total value acts as the tax base. Assuming the land in this hypothetical jurisdiction is valued at $8,000,000, a 5% levy would be necessary to provide the $400,000. The same homeowner, with a $16,000 lot, pays 5% of the value of his lot, or $800 in property taxes.

As generally conceived, the site-value tax system would ignore the manmade improvements to a piece of property. The value of a parcel is determined by its expected income in its highest use, given any locational or zoning restrictions which might apply to it.[4] The actual use of the parcel would be irrelevant. The site-value tax does, however, take into account a number of features which make that parcel more attractive to development, such as sewer and water connections, access to transportation routes and facilities, and grading.

arguments in favor of the site-value tax

Proponents of the site-value tax claim that their system benefits urban centers in a number of ways. First of all, it is a neutral tax. Under the current system, any benefit received for improving the land is decreased to some measure by an increase in the assessed value, and the tax levied thereupon. The extent to which the tax acts to discourage the improvement of property depends upon the tax base and revenue needs of a particular jurisdiction, but in any case, the effect of the tax is negative.[5]

The site-value tax, on the other hand, fixes the amount of tax paid on a particular parcel regardless of development which occurs on it. Because the benefit of any income-producing improvements to the land will accrue in full to the owner (taxes will not

Edwin Chester is a third year student in the joint degree program of the Department of City and Regional Planning and the School of Law at the University of North Carolina, Chapel Hill. He prepared the original draft of this paper during the summer of 1975 as an intern for the Office of State Planning, Raleigh, North Carolina.

increase with the increased income value of the improved property), no disincentives exist to put the land to its best use in order to maximize profits. The decision as to the type and scale of development depends upon market constraints other than the property tax, whose effect is neutralized.

Such a tax structure assists in solving problems of urban blight and ugliness.[6] Because the site-value tax does not affect property improvements, property owner's are not threatened with increased bills if they decide to renovate their premises—and need not be concerned the exterior appearance of buildings will increase taxes.[7] [8]

Site value taxation proponents also argue their system aids in deterring urban sprawl by encouraging more intense development near central cities.[9] The paradoxical element of the sprawl problem lies in the fact that many cities harbor large amounts of vacant land within their boundaries,[10] and yet constantly annex new areas which must be provided with roads, schools, sewer and water—expensive services already available within the city limits. The site value tax would substantially increase the cost of holding property vacant since about 60-70% of a city's tax base (the improvements to the land) is shifted to the land itself.

"(the site value) tax structure assists in solving problems of urban blight and ugliness."

encourages development

A site-value tax encourages development of existing vacant land in one of two ways: 1) Because the tax burden on the land is much greater under the site value system, the owner is motivated to develop the land to provide a steady stream of income for the payment of taxes; 2) the current system makes it relatively inexpensive to hold land out of productive use either consciously (by the speculator) or inadvertantly (by one who inherits property and does nothing with it out of sheer inertia). The increased tax burden encourages the transfer of that property, the value of which has decreased with the new burden, to someone better able or more willing to put the land into productive use.

An important part of this analysis, however, is the assumption that the demand exists to support the expansion of this productive capability.[11] In cities where a healthy demand does not exist, a site-value tax might result in a large number of tax delinquent judgments and subsequent city ownership of substantial amounts of property.[12]

equitable shifting of the tax burden

There are three lines of reasoning to support the claim that site-value taxation may result in a more equitable distribution of the tax burden: (1) it tends to shift the burden to those who can best afford it; (2) it acts to prevent the shifting of increased tax costs

A site value tax system would encourage a more intense and compact development of urban land

Photo by John Manuel

from the land owner to the tenant or ultimate consumer; and (3) it results in the recapture of socially created values.

Shifting the tax from the buildings and improvements to only the land itself will tend to put the tax burden on the wealthier individuals and corporations. Under either tax system land is an expensive commodity to invest in and to hold because of its unique nature and limited supply. As a rule, only the wealthy possess the liquid assets necessary for the initial equity payment and the further additional assets necessary to finance a piece of property of investment quality (large suburban tract or smaller inner city tract). In general, it is impractical to buy land in small bits, as transfer costs are high and a parcel's value usually increases more than proportionally with its size. It is far more convenient for even upper middle income investors to place their money in stocks, bonds, or savings certificates where the entry threshhold and transaction costs are relatively low. Thus, the emphasis on taxation of the land under a site-value tax system will tend to increase the tax burden of the wealthier individuals who can afford to invest in land.

Netzer argues that these 'wealthier' land owners would be unable to pass the increased tax expenses on to the consumer or tenant, because under reasonably competitive conditions, shifting is possible only when supply can be reduced. The supply of land is, of course, fixed, and a landowner could not be expected to withdraw his land from the market, because that would not remove his property from the tax rolls, but would merely decrease the income he could generate to cover the increased tax expenditures.[13] This is to be contrasted with the situation in which one taxes improvements to land. Improvements can be decreased and withdrawn from

supply thereby increasing the price of the remaining stock.[14]

The notion that a site-value tax will lead to the recapture of socially-created values is based on the idea that a dramatic increase in land values is rarely the result of the efforts of a particular land owner, but is rather the result of activities of the neighboring land owners, or community investments in public facilities, or the general growth of the population and economy.[15] For example, the construction of a fire station or highway can dramatically increase the value of a nearby parcel providing a windfall to the landowner as a result of community expenditure. Under either the site-value or current tax system the landowner's taxes will increase with the increase in land value, but the site-value tax would recapture a larger portion of the windfall because of its emphasis on the land value.[16]

affect on land uses

It seems clear that the site-value taxation could have beneficial effects on urban areas and their residents if current economic theory is correct in its analysis of the situation. What is not as clear is the effect the tax might have on specific types of land use. What little research has been done on the shifting of the tax burden among land use classes is inconclusive, as it is based on broad estimates of land-improvement ratios in various land use groups, and not on actual assessment data.[17] The data presented below were gathered to attempt to analyze the effects which a site-value tax might have in two North Carolina city-county areas.

the study areas

Durham and Mecklenberg Counties were chosen for the study, for the simple reason they were the only counties in which assessment figures were broken down into land and improvement components. In order to study the effects of a site value tax system on specific classes it is essential that the tax rolls include estimates of land vaules and improvement values separately. No other North Carolina counties have made the effort to assess property values by this more detailed method.

Photo by John Manuel

Apartment complexes would benefit greatly from the switch to a site value system

methodology

The data were available only in dollar amounts for each category (Residential, Manufacturing, Trade, etc.) of land use. Values for all classes were first summed to determined the value of the 'tax base'. This tax base figure was computed both for the combined land and improvements to establish the value of the current tax base (combined tax base), and then for only the land components to determine a value of the tax base under a site-value system (the land tax base).

In order to determine the share of the tax base which each land use represented under the current system, the combined land and improvements value for each class was divided into the 'combined tax base'. To calculate the share of the tax base represented by each class under a site-value tax the land component of each class was divided into the land tax base. Once the share of the tax base under each system was established, the shifting of the burden under a site-value system could be measured by comparing the share of each class under the current system to the share which each would represent under the site value tax system.

For example, imagine a taxing jurisdiction in which there were only residential land uses and manufacturing land uses. The land used for residential units is worth $200,000 and the buildings are worth $500,000. The land used for manufacturing is worth $50,000 and the buildings are worth $250,000. Under the current system the 'combined tax base' would be $200,000 + 500,000 + 50,000 + 250,000 = $1,000,000. The residential sector would represent 700,000/1,000,000 or 70% of that tax base and would pay 70% of the property taxes levied. Under a site-value tax system, however, the tax base would include only land values, and thus the 'land tax base' would be $200,000 + 50,000 = $250,000. The residential sector would then make up 200,000/250,000 or 80% of the tax base and would then pay 80% of the taxes levied. The residential sector's share of the tax burden would increase by about 15% under site-value tax system.

In order to evaluate the effect of a site value tax on both the city and county areas outside the city, this process was applied to both the city and county areas in each of the two counties.

The following matters relate to the quality of the data and should be kept in mind when evaluating the results:

(1) The figures reflect assessments of 1968 in Durham and 1971 in Mecklenburg counties, therefore a number of parcels may have changed substantially in value during the intervening years. But, the figures should accurately reflect the values of parcels in one category relative to those of other categories. Most categories included enough parcels so even major fluctuations in the value of a few

parcels should not significantly affect the results.

(2) The 'land' value figures provided by the counties may not be actual site values, as the assessors in these jurisdictions may well have taken into account the value of the improvements on the land in their estimate of its value. This type of technical difficulty can be expected, however, even under a pure site-value system.

the effect of site-evaluation taxation on land use classes

Presentation of the data have been organized on the basis of the land use code systems used by the two counties. The data are first examined by sector, and then as a whole. The word 'category' will be used to refer to one of the broad headings such as 'Residential' or 'Manufacturing', and the word 'class' is used to designate more specific uses within each category, such as 'multi-family dwellings' or 'parking facilities'.

residential land use

The residential land use category makes up a large part of the tax base of all areas both in terms of the number of parcels and in percentage of value. In Durham city and county, it represents about 60 percent of the tax base under the current system, and about 45 percent under the site-value system. (See Figure 1) The comparable figures for Charlotte and Mecklenberg County are about 50 percent and 40 percent (See Figure 2).

"The residential land use category makes up a large part of the tax base of all the areas both in terms of the number of parcels and in percent of value."

As a class, only mobile homes seem to suffer from the switch to site-value taxation in the Durham area and Mecklenburg County. Single family dwellings pay about 20 percent less, and multi-family dwellings pay from 43 to 75 percent less, while mobile home owners' taxes will more than double in the Durham area, and nearly double in Mecklenberg County. The tax bill for mobile homeowners in Charlotte decreases, but that class represents only ten parcels.

It is important to note that within the single family dwelling class, the switch does not affect all members equally. Figures were not supplied by Mecklenberg County, but Durham separated the single family class by value of the dwelling on the parcel. The least expensive housing would suffer a substantial increase in tax liability, with the switch to site-value taxation. In the city, the rate increases 45 percent for dwellings worth less than $5000, while 98 percent in the county. These dwellings tend to be rental units which operate on a relatively thin profit margin. A switch to site value taxation would require some special treatment for this sub-class, if cities were not prepared to take ownership of a large number of parcels through tax deliquency proceedings or see rentals at the low end of the market increased substantially.[18]

manufacturing

The manufacturing sector would benefit from a switch to site value taxation in all four of the areas, although the magnitude of the benefit varies greatly. In both Durham city and county, taxes due from the manufacturing sector decreases by about 40 percent with site value taxation. In Mecklenberg County, the drop is about 60 percent, while in Charlotte only 10 percent.

Note the manufacturing sector represents only about 2.5% of the tax base of the developed areas (except for Durham County) under the site-value system.

transportation and communication

Transportation and communication sectors suffer under the site value system, with tax bills in Durham and Charlotte increasing by 65 percent and 44 percent respectively. Parking facilities are most responsible for the increase, as they represent up to two-thirds of the tax base in this category. In both cities, parking facilities would be subject to tax increases approaching 200 percent under a site value taxation system. Utilities do not show a steady pattern. Communications appear to do better under the site-value system, and therefore, must be using the land quite intensively.

trade

In Charlotte under a site-value system, wholesale and retail trade would increase its share of the city tax base from about 10 percent to about 15 percent. In Durham the tax base share for this sector would rise from about 7 percent to about 10 percent. In the counties, however, a site value system would lower the proportion by 6 percent and 24 percent in Durham and Mecklenburg, respectively. Once again, it seems land is being more intensively used in the counties than in the urbanized areas.

Although the property tax for wholesale trade parcels decreases in all areas (considerably more in the counties), retail trade would suffer. Department stores would be hard hit, especially in the cities of Durham and Charlotte where taxes would rise by 36 percent and 27 percent respectively. Grocery stores would pay considerably more in Charlotte (69 percent), and somewhat more in Durham (12 percent) and Mecklenburg County (8 percent), but substantially less in Durham County (46 percent). The reason for the wide range is not clear, especially in light of the fact there are a substantial number of parcels in each of the areas. Automobile accessories (mostly gas stations) parcels would see substantial increases in all areas, but especially in the City of Charlotte where the tax bill for this class would increase by 140 percent.

Figure 1

	DURHAM CITY			DURHAM COUNTY		
	Portion of Current Tax Base	Portion Under Site Valuation	Percent Change	Portion of Current Tax Base	Portion Under Site Valuation	Percent Change
Residential						
Total	.602	.479	-20.5	.591	.435	-26.4
Multi-family	.121	.069	-43.3	.025	.006	-75.6
Single family Valued < $5,000	.039	.056	+44.8	.035	.069	+98.0
Manufacturing	.047	.025	-46.2	.004	.003	-37.5
Transportation and Communication	.032	.053	+65.7	.006	.007	+14.5
Trade	.072	.907	+34.5	.022	.021	-6.1
Services	.097	.127	+31.2	.095	.025	-73.2
Cultural Resources and Recreation	.009	.022	+146.0	.006	.008	+29.7
Resource Production and Extraction	.003	.002	-20.8	.009	.024	+168.5
Undeveloped and Water Areas	.092	.167	+81.9	.113	.307	+171.6

Figure 2

	CHARLOTTE			MECKLENBURG COUNTY		
	Portion of Current Tax Base	Portion Under Site Valuation	Percent Change	Portion of Current Tax Base	Portion Under Site Valuation	Percent Change
Residential						
Total	.544	.407	-25.1	.48	.382	-20.4
Multi-family	.090	.058	-35.7	.025	.009	-62.4
Single family Valued < $5,000	.026	.023	-10.2	.07	.027	-61.7
Manufacturing	.022	.032	+44.5	.018	.014	-23.9
Transportation and Communication	.104	.153	+46.7	.067	.051	-24.6
Trade	.153	.137	-10.2	.096	.060	-37.9
Services	.010	.013	+32.3	.015	.022	+46.3
Cultural Resources and Recreation	.00011	.00032	+190.9	.004	.006	+57.4
Undeveloped and Water Areas	.070	.178	+154.4	.212	.418	+97.1

It is argued the site value system would discourage urban sprawl

Photo by John Manuel

services

It is difficult to compare the totals for the service category as the land use codes do not correspond exactly. Individual classes should be fairly consistent, however, and within each county, the classes should be consistent.

In Durham County, the major decrease in the burden on this category appears to be due to the difference in business services class (advertising, credit and collection, and employment services) which makes up the bulk of the county tax base in the category.

The tax on governmental service land uses increases in all four areas, and especially in the two in Durham. To the extent this represents projects like sewage treatment plants and landfills, this may not indicate a less than optimal use of the land. At any rate, under the present system that land is exempt from taxation.

The difference in tax cost change for educational services between Durham-Durham County and Charlotte-Mecklenburg County is interesting in that it increases substantially in the former and decreases substantially in the latter. The magnitude of the difference may well indicate the two counties have used different classification requirements for their land use information.

cultural resources and recreation

The most important thing to notice about the classes in the cultural resources and recreation category is each represents a very small percentage of the total number of parcels in its respective area. The data are useful in spite of this, however, because of the consistency of the direction and magnitude of change in the tax burden which the site value taxation system would bring.

Taxes in this category would go up for almost every separate class in every area, as one might expect. Parks, recreational activities and public assembly areas are by their nature not intensive users of land, and to a great extent that may be their attraction. The fact that a good portion of the parcels in these classes may be tax exempt would moderate what appears to be an undesirable effect of site-value taxation. The fact that they represent a small share of the tax base (2.2% maximum) indicates a tax exempt status for the entire category would not greatly burden other categories.

resource production and extraction

The resource production and extraction category clearly suffers under a site-value taxation system, as the land is not intensively used. All agriculture and agriculture-related classes would be subject to increased tax burdens except in the city of Durham. Agricultural uses are hurt less in the Charlotte-Mecklenberg county area than in the other areas, although the increases are still quite substantial for a business where margins are generally thin.

Again it should be noted, that in these two counties the resource production and extractive sectors represent only very small shares of the tax base (2.5% maximum), and exempting them from the tax base altogether, or allowing them some form of tax credit would not substantially increase the burden on other classes, if the city/county felt a pressing need to preserve these uses for open space and diversity. Another good argument for some preferential treatment is that unless all counties in North Carolina were to implement site-value taxation, it would put those subject to the increased tax at a competitive disadvantage.

undeveloped areas

All undeveloped areas would be subject to substantially increased tax liability under a site-value taxation system, and indeed, this has been one of the major arguments in favor of the implementation of a site value system. The tax on undeveloped land increases no less than 80 percent in each of the areas, the tax on vacant floor area increases by more than 70 percent in all but one area, and the change for the category is very substantial for all areas.

Note also that in both county areas site-value taxation would require that vacant land support 30-40 percent of the tax debt, while in the cities it would support only 16-18 percent of the burden.

Conclusion

If its proponents are to be believed, site value taxation appears to have the potential to alleviate

some of the more devastating pressures on inner city areas. Unlike the current tax system, it would not act to penalize a property owner for his efforts to improve his property. It would encourage more compact patterns of development and thus decrease the amount of money needed to finance municipal services. And, it would tend to distribute the tax burden more equitably among city residents.

The data from this study support the conclusions that the majority of current economic theorists would posit. At least initially, non-intensive users of land such as less expensive residential units, gas stations and parking facilities, undeveloped land, agricultural land, and cultural and recreational uses

"The data from this study support the conclusions that the majority of current economic theorists would posit."

are forced to pay substantially higher taxes under a site-value tax system. The higher tax cost should encourage a more intense use of these activities either by decreasing the size of the parcels or increasing the value of the improvements to the parcel. At the same time, intensive land users such as expensive single family dwellings, multi-family dwellings, and the manufacturing sector in general, pay substantially lower taxes as a reward for their more intensive use of the community land resource.

The primary difficulties encountered in the case of the site-value tax system, however, are that many of the categories which are to be encouraged to make more intensive use of their land either: (1) cannot afford to pay the higher taxes or to invest in the improvements necessary to provide more intensive use; or (2) would lose most of their value as community resources if they were to use the land more intensively. Less expensive residential units are inhabited by the poorest members of the community and to increase their shelter costs or provide any disincentive to investment in these units would increase the burden of those who can least afford to bear it. Much of the attraction and benefit to the community of agricultural, recreational and cultural land uses is the result of their non-intensive use of the land. To encourage more intensive use in these categories would be counter-productive.

Fortunately, the class of land use which, for valid social reasons, might be in need of some protection against the effect of a site-value tax, represent a fairly small percentage of the tax base. Altogether, the classes of dwelling units worth less than $5000, resource extraction and production (primarily agriculture), and cultural and recreational uses do not represent more than about 8% of the tax base under a site-value tax system. Property taxes would not need to be foregone completely, but an abatement program could keep tax expenses at current levels without substantially increasing the burden on the other classes of uses.

Footnotes

[1]Department of Housing and Urban Development, *A Study of Property Taxes and Urban Blight*, January, 1973.

[2]Henry George, *Progress and Poverty; an Inquiry into the cause of the Industrial Depressions and of Want with Increase of Wealth; the Remedy*, (N.Y., Robert Schalkenback Foundation, 1962).

[3]Among the major obstacles to a site-value tax are the uniformity clauses found in most state constitutions, which require the taxation of all real property at a uniform rate (See N.C. Constitution Article V, Section 2(1) and Hajoca Corp. v. Clayton, 277 N.C. 560, 178 S.E. ed 481 1971). In those states where legislatively designated classes of property may be taxed at a different rate or exempted altogether [See NC Constitution Article V, Section 2, (2) (3)] the constitutionality of a site-value system would be left to the interpretations of the specific statues by the state courts.

[4]The technical difficulties which would be encountered in determining a pure 'site value' can be expected to be substantial. See Donald Hagman, "The Single Tax and Land Use Planning: Henry George Updated", 12 *U.C.L.A. L. Rev.* 762, 774 (1965). Whether precise assessment would be any more difficult under a site-value tax than it is under the current system is open to speculation.

[5]Schaaf argues to the contrary, that the present *ad valorem* tax is the neutral tax, in that it does not discriminate between land and improvements investments. Investors are not encouraged to invest their money in either the land or the improvement component because they will be taxed equally under any decision. A.H. Schaaf, "Some Uncertainties About the Desirability of Site-Value Taxation", *Tax Policy*, Vol. XXXVII, Sept.-Dec. 1970, p 34.

[6]But see L.A. Dougharty, "Forces Shaping Urban Development: The Property Tax" (Santa Monica, California, The Rand Corporation, June 1973) at p. 19 in which the author concludes that despite the weight of current opinion on this matter, empirical evidence has not yet conclusively proven that there is a direct relationship between the property tax and urban blight.

[7]Although this argument appears to be deductively sound, a recent study carried out for HUD has indicated that a fear of reassessment is not a major deterrent to the maintenance and renovation of property. George Petersen, *Property Taxes Housing and the Cities*, (Washington, D.C.: D.C. Heath & Co., 1973), p. 52.

[8]*But see*, Dougharty, *op. cit.*, p. 28-36, in which the author concludes that the current property tax system actually operates to discourage leap-frog development.

[9]Hagman argues that this effect of the site-value tax would make historic preservation by the private market much less feasible by encouraging building owners to renovate or demolish their premises in order to make them more efficient and profitable. Hagman, *op. cit.* p. 777.

[10]In Los Angeles, 65% of the land is vacant, in Dallas, 41%; and in Greensboro, 45%. Charles Liner, "Alternative Tax Programs and Land Use Policy", *Proceedings — Second Annual N.C. Land Use Congress* (December 1972). *But see* Hagman, *op. cit.* p. 765: Hagman estimates the normal figure to be 15-20%.

[11]See Arthur P. Becker, "Arguments for Changing the Real Estate Tax to a Land Value Tax", *Tax Policy*, Vol. XXXVII, Sept.-Dec. 1970. p. 16.

[12]See Hagman, *op. cit.*, p. 776.

[13]Dick Netzer, Economics of the Property Tax, (Washington D.C.: The Brookings Institute), 1966, p. 33.

[14]*Ibid.* m o, 36.

[15]For example, between 1956 and 1966 land values rose faster than the rate of inflation and three times faster than the consumer price index. See "Building the American City", Report of the National Commission on Urban Problems (Washington D.C.: House Document 91-34, 91st Congress, 1968). p. 385.

[16]Some of the limitations of this argument are presented in "Building the American City", *op. cit.*, p. 389.

[17]"The Impact of a Transition to Site-Value Taxation on Various Classes of Property in San Diego," *Land Economics*, Vol. 50, No. 2, May 1974, p. 181.

[18]The theoretical arguments which support this conclusion can be found in Shaaf, *op cit* p. 36 ff.

Carolina Planning
Department of City & Regional Planning
University of North Carolina
Chapel Hill, N.C. 27514

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